PROCEEDINGS

Eighty-Second Annual Convention

OF THE

American Railway
Bridge & Building Association

1977

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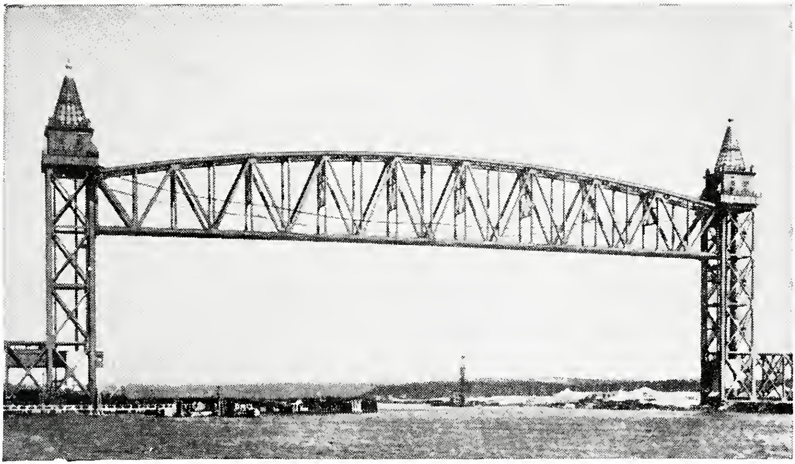

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Union Pacific Bridge No. 744 Kennewick, Wash.	1976
Elgin Joliet & Eastern Bridge #710 Chicago, Ill.	1973
Norfolk & Western Elizabeth River Bridge Norfolk, Virginia	1973
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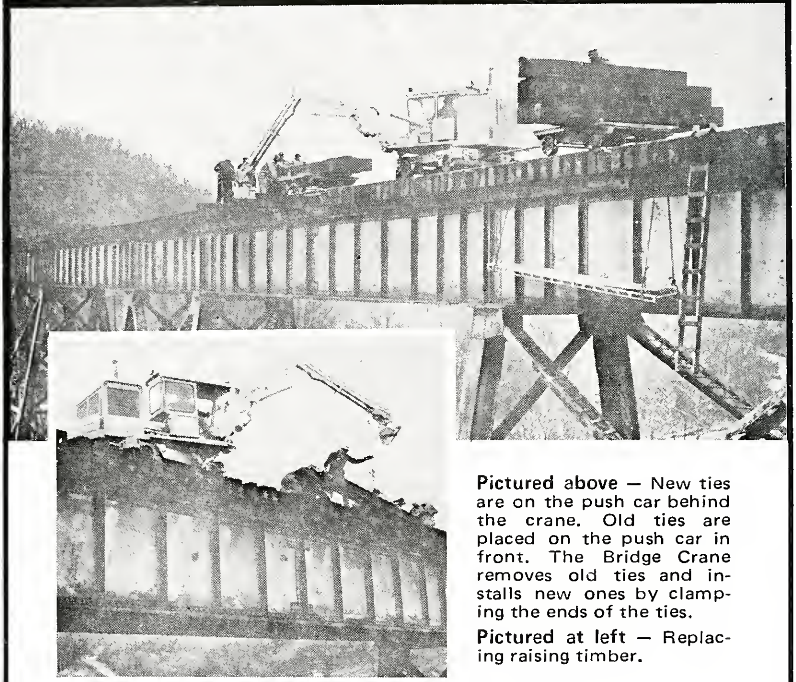
Benzal Bridge Benzal, Arkansas	1971
Berwick Bay Bridge Morgan City, La.	1970
Rob Roy Bridge Pine Bluff, Ark.	1970
Rock Island Bridge Little Rock, Ark.	1970
Willow Avenue Bridge Cleveland, Ohio	1964
Ohio Street Bridge Buffalo, N. Y.	1961
Arthur Kill Bridge Staten Island, N. Y.	1959
Wabash R. R. Bridge Valley City, Ill.	1959
Turtle River Bridge Brunswick, Ga.	1956
South Park Avenue Bridge Buffalo, N. Y.	1955
McNary Dam—Navigational Lock Bridge, Columbia River	1950
North State Street Bridge Chicago, Ill.	1949
The Canal Street Bridge Chicago, Ill.	1948
San Joaquin River Bridge Mossdale, Calif.	1948
The Commodore Schuyler F. Helm Bridge, Los Angeles, Calif.	1947
Lake Washington Floating Bridge Seattle, Wash.	1940
Lewiston-Clarkston Bridge Washington-Idaho Border	1939
Torrence Avenue Bridge Chicago, Ill.	1936
Cape Cod Canal Bridge Buzzards Bay, Mass.	1935

the NEW KERSHAW BRIDGE CRANE



Pictured above — New ties are on the push car behind the crane. Old ties are placed on the push car in front. The Bridge Crane removes old ties and installs new ones by clamping the ends of the ties.

Pictured at left — Replacing raising timber.

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Proceedings of the

Eighty-Second Annual Convention

of the

American Railway
Bridge & Building
Association

Held at

CHICAGO, ILLINOIS

September 26-28, 1977

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TABLE OF CONTENTS

Page
Officers for the Fiscal Year September 1976—September 1977 6
Officers for the Fiscal Year September 1977—September 1978 7
Opening Session 11
Secretary's Report 98
Treasurer's Report 99
Report of Necrology Committee 101
Past Officers 115
Historical 119
Constitution 121

ADDRESSES AND COMMITTEE REPORTS

Facility for Accelerated Service Testing—Address by Robert Parsons 15
Private Enterprise—Address by Tracy Kelly 21
Keynote Address—By W. H. Dempsey 28
President's Message—By Warren H. Rankin 36
Replacing or Making Heavy Repairs to Bridges Having Continuous Welded Rail—Committee Report 39
Effect of Unit Train Operation on Bridges—Committee Report 42
Wood Decay in Bridges—Address by Joe Clark 47
A Positive Look Ahead—Address by R. C. Grayson 51
Amtrak and Its Relationship to Maintenance of Way Activities in the Northeast Corridor—Address by R. F. Lawson 56

SYMPOSIUM ON CROSSTIES

Timber Ties—Address by Gerald M. Titus 66
Concrete Ties—Address by John Weber 70
Reconstituted Timber Ties—Address by Edward Potter 76

SYMPOSIUM ON FIRE RETARDATION FOR BRIDGE DECKS

Introduction—By W. R. Hyma 84
Pressure Impregnation of Fire Retardant Materials—Address by W. T. Henry 85
Applications of Fire Retardant Treated Wood—Address by Henry Mader 87
Coating Open-Deck Bridges for Prevention of Fire—Address by J. B. Ledingham 90
Field Application of Fire Retardant Material—Address by Kenneth Norton 92
Maintenance of Branch Line Bridges—Committee Report 94
Review of Procedures and Methods for Undertrack Tunnel Construction—Address by R. L. Standley 103
MoPac Concrete Products Yard—Address by J. W. Chambers 104
Design and Production of Pre-stressed Concrete Girders—Address by R. L. Thielemier 109
New Techniques for Concrete Restoration—Address by A. A. Hill (1976 Convention) 114

INDEX TO ADVERTISERS

Page
Alert Manufacturing & Supply Co. .... 126 and 128
American Hoist & Derrick Company 127
Anderson Company, The 129
Berkel & Company, Constructors, Inc. 125
Bogle Company, The R. H. 169
Ciba-Geigy Corporation 136-137
Conley Frog & Switch Company 131
Conomos, Inc., John B. 146
duPont de Nemours & Co., Inc., E. I. 133
Elanco Products Company 173
FMC Corp., Crane & Excavator Div. 175
Fairmont Railway Motors, Inc. 139
Fulton Supply Company 135
Greiner Engineering Sciences, Inc. 138
Herzog Contracting Corp. 167
Huck Manufacturing Company 140
Industrial Track Supply Company 171
Intrusion-Prepakt, Inc. 141
Kershaw Manufacturing Co., Inc. .... Front Fly Leaf
Koppers Company, Inc. 143
Lewis Bolt & Nut Company 150
Loram Maintenance of Way, Inc. 145
MKT Corporation 154
Manta, Inc., J. L. 152
Marmon Transmotive 155
NL Industries, Inc., Industrial Chemicals Div. 156
Osmose Wood Preserving Co. Railroad Div. 147
Ozark Railway Supplies, Inc. 132
Paxton-Mitchell Company 158
Penetryn System, Inc. 157
Pettibone Corporation—Railroad Div. .... Back Fly Leaf
Plasser American Corporation 144
Racine Railroad Products, Inc. 153
Rails Company, The 151
Sika Chemical Corporation 149
Southern Wood Piedmont Company 160
Teleweld, Inc. 165
Templeton, Kenly & Company 163
Torrington Company, The .... Back Fly Leaf
Turzillo Contracting Company, Lee 159
URS Corporation 161

PROFESSIONAL SERVICES DIRECTORY

	Page
Acres American, Incorporated	183
Baker, Wibberley & Associates	183
Baker, Jr., Inc., Michael	183
Benesch & Co. — Engineers, Alfred	183
Booker Associates, Inc.	183
Bucher & Willis Consulting Engineers	184
Clark, Dietz & Associates — Engineers, Inc.	184
Clough Associates	184
Cowin & Company	184
De Leuw, Cather & Company	185
Earle Gear & Machine Company	185
Envirodyne Engineers	185
Gannett, Fleming, Corddry & Carpenter, Inc.	185
General Construction Company	186
Green International, Inc.	185
Hardesty & Hanover	186
Harris, Inc., Frederic R.	186
Hazelet & Erdal	186
Henningson, Durham & Richardson	187
Hydro Conduit Corporation	187
Ketler Company, F. K.	187
Keyes Associates	188
Lummus, Inc., M.	187
Miller Company, The Ellington	188
Modjeski & Masters	188
Moon & Sons, Inc., John H.	189
Parsons Brinckerhoff Centec Inc.	186
Pavlo Engineering Co., P. C.	188
Railway Techniques, Inc.	189
Riley, Park, Hayden & Associates, Inc.	189
Sverdrup & Parcel & Associates, Inc.	190
Tippetts-Abbett-McCarthy-Stratton	189
Urban Engineers, Inc.	190
Vierling Steel Works	190
Weidlinger Associates	190
Whitehead & Associates, Ralph	190

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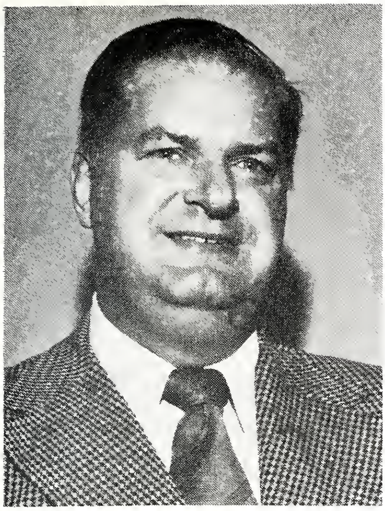
American Railway Bridge & Building Association

Sept. 1977 – Sept. 1978



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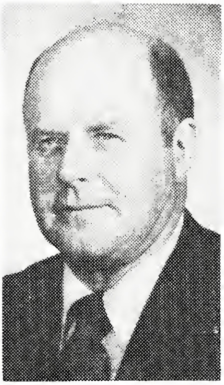

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Memoir

Henry Moffett Harlow

1907-1976

Henry Moffett Harlow, retired Assistant Engineer, Bridge & Building Construction and Maintenance, Chessie System, Huntington, West Virginia, died September 5, 1976 in Richmond, Virginia.

Mr. Harlow was born February 2, 1907 at Huntington, West Virginia and he graduated from Marshall University in 1928. He began work with C&O - B&O as a carpenter helper. In 1937 he became assistant supervisor B&B and was appointed assistant general supervisor B&B at Richmond from 1941-1965. August 1966 he was appointed assistant engineer B&B construction and maintenance at Huntington, W. Virginia which was the position he held at the time of his retirement in May 1969.

Mr. Harlow became a member of the ARB&BA in March 1939, and a director of the Association in 1946. In 1950 he was elected 4th Vice President and advanced each year to become President in 1954. He was made a Life Member in 1969. He was also a member of the American Railway Engineering Association.

Memoir

John Joseph Ridgeway

1912-1977

John Joseph Ridgeway, Director of Engineering Services for the Bessemer and Lake Erie Railroad Company, Greenville, Pennsylvania, died July 27, 1977, at Buffalo, New York. He is survived by his widow, Nancy Shiver Ridgeway; his mother, Mrs. Stella Ridgeway of Sharon, Pennsylvania; a daughter, Mrs. Penny Lee Hittle; a son, John Terry Ridgeway; one grand-daughter, and one grandson.

Mr. Ridgeway was born July 18, 1912, at Point Marion, Pennsylvania, and was a graduate civil engineer from West Virginia University. He began work for the Bessemer and Lake Erie Railroad Company in Greenville, Pennsylvania, as an Assistant Supervisor structures in 1946. He was promoted to Acting Supervisor Structures in the same year, and in 1947 was appointed Supervisor Structures. In 1959 he was named Engineer Structures-Processes and then Project Manager in 1970. Then in 1972 he was promoted to Director Engineering Services, which was the position he held at the time of his death.

Mr. Ridgeway became a member of the American Railway Engineering Association in 1964, and held the position of Chairman of Committee 7, Timber Structures. He joined the American Railway Bridge and Building Association in 1957, in which he held many offices, until becoming President in 1974. His participation and dedication to the railway engineering field will be greatly missed by his fellow members of the Association.

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PROCEEDINGS

REGISTRATION totaled 731 railroaders and 140 ladies.

September 26, 1977

A Joint Session of the Roadmasters' and Maintenance of Way Association and the American Railway Bridge & Building Association was called to order at the Hyatt Regency Hotel, Chicago, September 26, 1977, at 9:30 A.M., Mr. W. J. Cruse, President of the Roadmasters and Maintenance of Way Association, presiding.

President Cruse: Will the attendants at the door please inform the people outside to come in. We are going to open the session.

As President of the Roadmasters and Maintenance of Way Association of America and on behalf of Mr. Rankin, President of the American Railway Bridge & Building Association, I declare this 89th Annual Convention of the Roadmasters' and Maintenance of Way Association of America and the 82nd Annual Convention of the American Railway Bridge & Building Association to be open in joint session.

It is proper that we pause and ask for divine guidance and inspiration prior to commencing our meeting. I would like to introduce the Reverend Le Roy Cronkhite II, Pastor of the Central Church of Chicago, who will deliver the Invocation. Reverend Cronkhite.

Rev. Cronkhite: All stand, please.

O Lord God, at the beginning of this convention we pause to acknowledge our relatedness to each other through You, who are the Father of all.

We recognize we are living in what are momentous times. Help us to see and to sense the destiny that lies ahead for these organizations, for each one represented here. For we recognize, Our Father, that what is good for the group must also necessarily be good for the individual, but help us that we may never lose sight of the fact that what is good for an individual must also be good for the group.

Help us, our Father, to sense that we have important things to do here and that they may be accomplished according to your will. May your guiding and pervading influence be felt throughout the sessions of this convention. And give to each one a strong sense of fellowship and participation, and a part in all that takes place.

For your presence now and always, we pray in His name. Amen.

President Cruse: Thank you, Reverend Cronkhite. Please feel free to leave whenever you wish. Of course, should you care to remain for all or part of our program, you are certainly welcome to do so. Thank you.

I join President Rankin in welcoming you to the first Joint Session of the two Associations. We certainly hope that you will enjoy your visit to Chicago. We have done our best to put on good weather for you. And we urge you to attend all the sessions of the convention.

The Committees of these two Associations have worked hard in preparing these programs and we are confident that they will be a real benefit to you and your railroad.

We have a very interesting program for the ladies. Registration is in the Water Tower Room, where they will be served coffee and rolls each morning. And an interesting trip is planned for them tomorrow.

I will now turn the meeting over to President Rankin of the American Railway Bridge & Building Association. Mr. Rankin.

President Rankin: As President of the American Railway Bridge & Building Association, I join President Cruse in welcoming fellow members of both Associations to this the 89th Annual Convention of the Roadmasters and Maintenance of Way Association and the 82nd Annual Convention of the Bridge & Building Association, and the 32nd consecutive Annual Joint Meetings of our two Associations.

We urge your attendance at all sessions of the program. Reports have been prepared by the diligent efforts of some of your fellow members and should be of benefit to you and your companies. Valuable information may be obtained through association with your friends at this time.

The ladies will also have an enjoyable program. We invite their attendance to any of our sessions in which they may be interested.

This afternoon, the Roadmasters will convene in Regency Rooms "C" and "D," these rooms here, while the Bridge & Building Association will convene in separate session Regency Room "B" starting at 1:30.

At this time I would like to introduce some of our Executive Committee whose volunteer efforts make possible this convention. Those with duties demanding their presence elsewhere will be with us at the session tomorrow.

Will the gentlemen please stand as their names are called and remain standing until all have been introduced and please withhold your applause until all have been introduced.

Starting at my extreme left, Mr. W. C. Sturm, our 2nd Vice President, Senior Project Engineer for the E. J. & E. Railroad at Joliet, Illinois.

Mr. D. C. Gould, Assistant Structural Engineer, Union Pacific Railroad, Omaha, Nebraska.

Mr. W. H. Huffman, Treasurer, Retired Assistant Vice President and Chief Engineer, Chicago & North Western Railroad, Wilmette, Illinois.

Mr. W. J. Gunkle, who is a Director. He is Senior Structural Inspector for ConRail at Philadelphia, Pennsylvania.

Mr. W. E. Halley, also a Director. He is Manager of Fire Prevention for the Chicago & North Western Railroad in Chicago.

Mr. K. L. Wammel, a Director, Assistant Division Engineer for the Southern Pacific Railroad, Portland, Oregon.

Mr. J. W. Chambers, Director, Bridge Construction Engineer of the MoPac Railroad, St. Louis, Missouri.

Mr. M. Novszewski, who is a Director, Bridge Engineer for the Illinois Central Gulf Railroad, Chicago.

Mr. J. R. Williams, who is our immediate Past President, Engineer of Bridges, Chicago, Rock Island & Pacific Railroad here in Chicago.

Mr. J. R. Iwinski, who is our First Vice President, Chief Engineer, Public Works, Chicago & North Western, Chicago.

You may applaud this fine group. (Applause)

I now return the rostrum to President Cruse.

President Cruse: I would like to introduce some of the Officers and Directors of the Roadmasters and Maintenance of Way Association. There are a number of others who could not be here at this time because of their other duties and attending to the affairs of the Convention. Will you please withhold your applause until they have all been introduced. As I call their names, they will stand.

At my extreme right, Mr. H. M. Hamilton, Director, Engineer, Track and Roadway, Canadian National Railways, Capreol, Canada.

Mr. K. W. Sutherland, Director, Supervisor, Maintenance of Way, Canadian Pacific Limited, Toronto, Canada.

Mr. W. H. Ferryman, Director of Construction Projects, Director, Burlington Northern, Casper, Wyoming.

Mr. B. D. Sorrels, District Engineer, Director, Atchison, Topeka & Santa Fe Railway, Amarillo, Texas.

Dr. W. W. Hay, Professor of Railway Civil Engineering, University of Illinois, Urbana, Illinois, Director.

A Director, M. S. McClendon, General Roadmaster Systems, St. Louis & San Francisco, Vinita, Oklahoma.

The 2nd Vice President, R. E. Frame, Director of Rehabilitation & Capital Planning, Consolidated Rail Corporation, Philadelphia, Pa.

1st Vice President, R. K. Pullem, Division Manager, Engineering, Chessie System, Akron, Ohio.

Treasurer, Mr. H. D. Hahn, Bridge Engineer, Chicago & North Western Transportation Company, Chicago, Illinois.

You may now applaud. (Applause)

I will turn the rostrum back to President Rankin.

President Rankin: We are indeed fortunate to have with us the Chief Executive Officer of another allied Railway Engineering organization. Many of you here are also members of that organization. I refer to the American Railway Engineering Association. With pleasure, I present to you Mr. B. J. Worley, President, and Chief Engineer of the Milwaukee Railroad, and President of the AREA. Mr. Worley would like to make a few comments at this time.

Greetings from AREA

Mr. Worley: Mr. Rankin, Mr. Cruse, members of the Roadmasters & Maintenance of Way Association, the American Railway Bridge & Building Association, and guests:

I am delighted to be here today to bring you greetings and best wishes from all the officers and members of the American Railway Engineering Association.

The programs of both Associations look very interesting to me and I look forward to attending as many of the sessions as possible.

There has been a large turnover in supervision in both Track and Bridge and Building Departments over the past few years, due to retirements, force fluctuations, and other reasons. The result is that we now have more new, inexperienced personnel in track and B & B areas than has been known for many years. The need for training of Maintenance of Way personnel is paramount in the railroad industry today.

Your Associations are performing an important training function in bringing together track and B & B Managers to learn from the various papers presented and the discussions that follow.

I also want to commend the supply people for the support that they have given these associations. It is through the combined efforts of the supply people and the Railroad Maintenance of Way people that new ideas are generated. Together, progress is being made and with the innovation that I see in my crystal ball, we have only begun to scratch the surface.

I would like to extend to each of you an invitation to attend the AREA Regional Meeting, which will be held in New Orleans on October 25th. Mr. Joel Devalle, Bridge Enginer of the Southern, is Chairman of this meeting. The theme of the meeting is "The Building Of A Modern Railroad Down South."

Our next Annual Technical Conference will be held in Chicago, March 22, 23 and 24, at the Palmer House. Mr. Earl Hodgkins and the Board are actively working on a program which I am sure will be of interest to you.

Thank you, Warren, for giving me a few minutes to bring greetings from AREA this morning, and I trust that both Associations will have successful meetings. Thank you. (Applause)

President Rankin: Thank you, Mr. Worley, for your comments. We are happy to have you with us and hope your busy schedule can afford some time to join us in some of our sessions.

At this time, we want to recognize another guiding force of the AREA. Will Mr. Earl W. Hodgkins please stand and be recognized. (Applause)

I now return the rostrum to President Cruse.

President Cruse: There is another organization that works very closely with the Roadmasters and the Bridge & Building Association in making this convention a success. This is the Railway Engineering-Maintenance Suppliers' Association, more commonly known as

REMSA. Now I would like to introduce Mr. Jerry H. Hines of Pandrol, Limited United States Branch, President of REMSA. Jerry.

Greetings from REMSA

Mr. Hines: Thank you, Bill.

President Cruse, President Rankin, special guests, ladies and gentlemen:

It is indeed an honor for me as President of REMSA to be asked to join in welcoming you to your Annual Convention. I know that all members of REMSA join me in wishing you a very successful and productive 1977 meeting.

At this time, I would like to present to Bill Cruse REMSA's Gold Medal, which reads:

"President, Roadmasters' and Maintenance of Way Association of America, 1976-1977."

Bill, Congratulations. (Applause)

President Cruse: I'm proud to accept this emblem of office. It will bring me many fond memories of my associations and acquaintances with all of you people. Thank you.

Mr. Hines: Also, to Warren Rankin, I would like to present on behalf of our membership a matching pin which reads:

"President, American Railway Bridge & Building Association — 1976-1977." Warren. (Applause)

Congratulations.

Mr. Rankin: Thank you, Jerry. I will cherish and proudly wear this memento of the fine organizations it represents and the fine relationships we have enjoyed with your organization.

Mr. Hines: Thank you very much.

We all certainly hope that your stay in the Hyatt Regency, as well as your stay in the City of Chicago, will be pleasant. The Officers and Directors of REMSA are at your call. If there is anything we can do to make your stay more enjoyable or problem-free, please call on us.

We know that many of you are looking forward to the Annual Banquet Tuesday evening in the Regency Ballroom. Complimentary tickets, as usual, are available for all registered railroad personnel and their wives. You will hear more about the entertainment at the Banquet shortly. Thank you very much. (Applause)

President Cruse: Thank you very much, Mr. Hines.

I would like now to introduce Mr. R. C. Crosby, Railway Products, Mormon Transmotive, Second Vice President of REMSA and he has a few words to say. Bob.

Mr. Crosby: Mr. Cruse, Mr. Rankin, Mr. Worley:

Tomorrow night is Mardi Gras Night. We're jumping the gun on the October meeting. But the theme of the REMSA Party, which will be held here in this Ballroom is Mardi Gras. The doors will open at 6:30. We'll have the Musical Trio to welcome you and your ladies. We have a fine program and dinner. The program is headed by John Matson and Nona McCall. We have a comedy group. We think it's going to be a fast pace, enjoyable show for you. As usual, our good friend Benny Sharp is in charge. We're all familiar with him and if we have a friend in town, it's Benny Sharp. I'm sure you will enjoy him and his Orchestra.

The tickets, as they have in the past, are issued when you register. So, when you register, get your tickets and your table assignment. It's going to be a good show. We hope you will all attend. It's our pleasure to be host for this party. And as in the past, we look forward to a fine evening. Hope you'll try to get out of here early tomorrow night so you will be able to participate in the various hospitality suites and have a good time.

Mr. Cruse, we have another meeting, Jerry and I, and if you will be so kind as to excuse us, please. We must attend another meeting. We regret it.

President Cruse: You are excused. When you're through with your other meeting, come back.

Is Mr. Dempsey in the audience? Our Keynote Speaker, Mr. Dempsey, has probably been detained. We will move on and I will turn the rostrum over to Mr. Rankin and we'll move on with the next speaker and pick up Mr. Dempsey later.

President Rankin: To tell us of the Department of Transportation's efforts and facility for accelerated service testing, known as FASTRACK, we are privileged to have with us Mr. Robert E. Parsons, Associate Administrator of the Federal Railroad Administration's Office of Research and Development.

He received his Mechanical Engineering Degree in 1954 from the University of Cincinnati and his Master's Degree in 1959 from the Drexel Institute of Technology.

He is a Registered Professional Engineer in the States of Ohio and Maryland.

From 1954 to 1956, he served as an Army Maintenance Officer in Germany.

Prior to his government service, he was with an aircraft and electronics systems manufacturing firm in Baltimore, Maryland, and with the Cincinnati Milling Machine Company.

His federal career began in 1964 as a value analysis engineer for the FFA.

In 1966, he was appointed Chief of the Analysis and Control Division, and from 1969 until 1971 was acting Deputy Director, Office of Supersonic Transport Development.

In 1975, he was appointed to his present position.

It is with pleasure that I present to you Mr. Robert Parsons. (Applause)

Facility for Accelerated Service Testing

By ROBERT PARSONS

Associate Administrator for Research and Development, DOT, Washington, D.C.

Thank you, Warren, President Cruse, President Rankin, Mr. Worley, Executive Committee, Officers and guests, ladies and gentlemen:

It is certainly my pleasure to be here with you in Chicago during such a pretty week and to spend this morning with you and to pass on the greetings of my boss, Jack Sullivan, who wishes you the best in your joint session here in Chicago.

I would go anywhere to talk about FAST. It sort of captures the fancy of us in the Federal Railroad Administration and without the enthusiastic support of the industry itself, a large portion of you here at this meeting, I would not be able to talk about this project, so it is a sincere pleasure to be here.

I believe this to be one of the most important railroad research projects we have ever conducted, either in the pri-

Robert Parsons

vate or public sector. Hopefully, it is a pattern that will be followed.

Most of you know about FAST and what it stands for. It is Facility For Accelerated Service Testing. It's a facility that we have copied after those in the Eastern Bloc countries, namely Czechoslovakia and Russia, who have had such facilities for quite a few years to help steer their scarce capital investments.

It is under the direction of the FRA, out at our Transportation Test Center at Pueblo, Colorado. However, it is jointly managed and the AAR has a program office right on our facility and we work day and day with our government counterparts, assuring the competitive spirit of the project.

It is cooperative in nature. We, as in many of our cooperative programs, are sharing the worries and cost and what glory there is with the Association of American Railroads, and the Railway Progress Institute and individual companies and suppliers.

I have assumed this audience is familiar with FAST, and its concept. I assume, also, and probably correctly on the latter, that you are primarily interested with track experiments. However, I am not going to spend a whole lot of time with the overview and I'm going to risk getting into a few of the results to date. I am going to use some slides to help me. While it will be primarily in the roadbed, I have a few examples of rolling stock experience as well.

One of the reasons I have made the assumption that you are familiar with FAST is through the media. I would like to publicly thank the press for the fine way in which FAST and the contributions of both the private and public sectors have been acknowledged.

I will move to the slides now.

The purpose of the project is fairly clear. As its name portrays, it is to obtain life cycle data on an accelerated basis on the performance of both track and on rolling components. However, it may be more important than these two objectives to obtain knowledge of the effectiveness of various techniques.

The idea and the impetus behind the project was brought in primarily by a few key industry leaders, but government help was needed to get the ball rolling. Therefore, as early as October of '75, initial planning was under way and the characteristics of the project were developed through a very intensive coordination effort subject to recognized time and resources.

We started the program sort of on a bootstrap principle and resources were hard to come by on the first loop. We used the committee structure of the industry and added a few government personnel to those groups and this is the way in which all the experiments to date have been framed. They have been framed by this joint action and while it has been a little difficult at times, I think in the long run it has been better for all concerned.

The physical plant itself is made up of 4.8 miles of track, divided into 22 test sections, and they contain a variety of experiments. At the time we are giving this paper we have accumulated approximately 125 million gross ton miles and have generated over 66 miles on the consist.

While I will not review the construction of the facility here — again I am assuming that through the press most of us are aware of it — I think it is worth mentioning that this entire project was built by the summer of '77 from a plan beginning in late '75. This would never have been possible in the normal government process without the extreme cooperation and, particularly, the financing that industry advances, especially in the early stage, while I was obtaining governmental approval for our share.

To date, about $10 million has been expended and about $2½ to $3 million of this, solely by the private sector in a "no strings attached" basis.

Before I get into the results, I would like to list a few of the limitations of the first experiment and some of our shortcomings — qualifications, if you will.

I would like to emphasize that our data analysis is far from complete. While the concept of accelerated life testing is easy to comprehend, the collection, processing and interpreting of the mass of data we have collected is still something about which we have a lot to learn.

At present, the track contains over 60% curves. With a consist of four locomotives and 80 cars, the train is, in effect, in a continual curve at a modest speed of about 40 miles per hour. This condition alone biases some of the test results. While we are running a unit train — mostly 100-ton hopper cars — it is unlike unit trains you run in that it is loaded in both directions. We have had start-up problems and will continue to have new phenomena. By new phenomena, I mean those that are very difficult for us to explain. But with that we are still learning and I would like to stick my neck out a little bit and try to interpret some of the early results.

A few of the observed results are not tentative. Rather, they have been established, primarily in revenue service, and FAST has just reinforced that.

This particular slide shows the steel tie fasteners which exhibit early fatigue problems, and forced the removal of all these ties at about 25 MGT. An inspection of the same type of steel tie installation in revenue service about the same time also revealed similar failure mechanisms. Both groups of steel ties have since been removed. They were subject to about the same MGT. However, the time spans on FAST were dramatic in that we discovered this within the first five to six months, while the revenue traffic had been in service for over 30 months.

The original FAST switch points required considerable grinding and sometimes required replacement. This was especially true for those in diverging moves. Two manganese switch points were field installed at about 30 MGT. This was the first time that such a field application had been attempted. The existing top surface of the point was ground off and the new point bolted to the movable point. A small amount of grinding is still necessary but the manganese tips are exhibiting far greater life as compared to the standard steel points.

Many other aspects of the FAST track at this stage of MGT have not provided direct conclusions. However, statements can be made which relate to the fact that many tracks in revenue service exhibit similar wear patterns. The examples that follow illustrate that FAST track performance is not entirely different from that being experienced in revenue.

FAST rail wear varies considerably around the loop. Some of this probably is due to the non-uniformity of rail lubricators. Many of the other items also affect rail wear, but for FAST the fact that all wheels at the beginning had the same new profile was a significant contributing factor in rail performance. When FAST wear data and rail profiles are compared to rail data from unit train operations, similarities can be found.

Rail corrugations were observed on the low rail on all of our curves. Corrugations exist in revenue service not totally unlike those we have at Pueblo. Data are now being collected to determine if any correlations exist between other test variations and the amplitude, wave length and location of rail corrugations we're experiencing. The rail has now been ground and all of the necessary data have been collected and analysis is proceeding.

FAST special track work, such as turnouts, frogs — some of which, by the way, have been removed — and insulated joints, have required more maintenance than the conventional track sections. Maintenance has been mainly in the form of tamping to maintain track geometry and uniform support conditions. This, also, is comparable to revenue service conditions where special track work requires more maintenance support. Therefore, this extra maintenance was expected. Again, we are collecting maintenance man-hours by component as part of our overall investigation and these comparisons will eventually be published.

I would like to spend just a moment or two on the concrete and wood tie performance data that we have been collecting at the test center. As you are aware, the Department of Transportation Secretary, Brock Adams, recently announced the decision to install 400 track miles of concrete ties in the Northeast Corridor. This has focused a considerable amount of attention to the large amount of concrete tie testing we are jointly doing in FAST today.

The trend from the data on newly constructed concrete ties versus the wood ties indicates a larger amount of settlement of concrete ties versus new wood ties. It appears that concrete ties settle faster under the first 20 MGT than that from 20 to 40, in which both wood and concrete settle at about the same rate. This result is supported by results from the ORE track test loop at Velim, Czechoslovakia, although they have just accumulated 33 MGT's to date.

In contrast to these results on a new embankment, the evidence at Velim for concrete tie track built on an existing roadbed showed considerably less settlement. This suggests that embankment and ballast conditions for new and rebuilt track may have a more significant effect on the overall settlement than on the tie type, per se. This does not appear to be the case, however, when evaluating uniformity in track settlement. There is a difference between the concrete and wood tie in differential settlement, which is attributable to the tie type. Concrete tie track appears to be settling more uniformly and, as a result, the surface and profile geometry should be better. As yet, however, the track geometry data that we have collected in Pueblo has not been conclusive enough to bear out this observation. More study of the future track geometry data at FAST is needed before we can verify that last statement.

The use of track geometry data at FAST to evaluate the performance of concrete versus wood ties was limited to an evaluation of gauge. The data from FAST indicates, as has been reported from other observations of concrete tie track, that concrete tie track has superior gauge retention capabilities as compared to conventional wood tie track.

Other data on track alignment errors from European and domestic railroads show that concrete ties have a lower rate of geometry deterioration than comparable wood tie track. The results of the settlement and track geometry data are borne out by the results of the vertical and horizontal track moduli tests, where the concrete tie track was stiffer than the comparable wood tie section. The stiffer section should result in better track geometry retention and it should, for the greater lateral resistance shown, provide greater stability, particularly on continuously welded rail.

The performance of concrete tie track is affected by one major consideration, track maintenance and original construction. From the evidence of the data we have collected and from observations of the track maintenance and construction, it must be noted that the equipment and operations should be modified from that used for wood tie track. The concrete tie is heavier, has special fasteners, and will not withstand the large center-bound loading conditions. Therefore, the normal track construction and maintenance techniques and equipment may require modification before performing adequately on a concrete tie track section.

Also to be considered are the quality control aspects of each component, which must be monitored to be assured of an adequate functioning system. In a sense, this applies to all other aspects of FAST as well as track. The amount of maintenance on FAST track sections has varied from none in some areas to much more than was planned in others. For example, many field welds have failed or have been removed following ultrasonic inspections. In contrast, shop welds of similar rail metallurgy have experienced only one failure to date. Due to a lack of available resources, there were instances where continuous welded rail had bolted joints for as much as 15 MFT before new field welds could be completed. As a result of these joints in the CWR, some FAST sections experienced conditions which created abnormal loads of track components and added additional maintenance requirements. This is indicative of the need to have good quality control in field welding and move in fast on defects.

It is evident that even on FAST, with its higher average occurrence of high vertical wheel-rail loads, the bending moments for the concrete ties at the rail seat and at the tie center are low in comparison to the ultimate strength of the tie, but they compare well with data from other test tracks. This would suggest that a possible failure mechanism for concrete ties is fatigue rather than peak loads.

Since FAST has only 125 MFT to date, and the evidence of wheel flats at our facility is small, a continued assessment of the performance in this area and many other test sites is needed to verify the statement I just made. In any case, however, the bending moments on the concrete ties at FAST are well within those required by the AREA specifications. As you could expect from the MGT levels to date, there are no ties that have structural cracks due to service conditions.

The only measure of performance that indicated a condition that would affect the maintainability of the concrete tie was tie movement. This tie movement was symptomatic of the severe conditions created at FAST by the use of rail plugs at the point of field weld failures and by the existence of rail corrugations on the low rail in curves, both of which, we believe, caused several soft spots to occur in Section 17. These soft spots were at the points where the ties were moving excessively, much as wood ties move near bolted joints. It is evident from what we have learned at FAST to date that the existence of jointed track and large rail corrugations in concrete ties cannot be tolerated.

The performance of the concrete tie fastener system, clips, pads and insulators have been satisfactory. There has been some insulator movement and some cracking and some fasteners have been loosened, but as yet this has not been a critical performance or maintenance problem.

The spring type fastener and tie plate on wood appears to reduce the tie plate cutting when compared to cut spikes and standard tie plates. However, due to the shortness of the test section and the short test period, no other substantive FAST data are available on the fastener system at this time.

Based on measurements taken at the gauge point, wear increases in the following order: (I'll try to extrapolate these curves. I know they are difficult to read.)

Head hardened and chrome moly, fully heat treated and high silicon, and standard. For the conditions at Pueblo and without complete knowledge of the effects of grinding and lubrication, I will stick my neck out and extrapolate these curves in terms of a tentative rail replacement schedule.

Head hardened — 300 MGT
Chrome Moly — 230
High silicon — 170
Fully heat treated — 160
Standard — 120.

Again, before anybody gets too excited, let me emphasize that we still have incomplete knowledge and only until we run tonnage in excess of the amounts I just mentioned will we really know when we are going to have to make replacements.

There is also a trend in the data that show rail wear is greater on the 1:14 cant tie plate. This trend is not conclusively proved from data collected up to the 125 MGT, and may only be indicative of the wear pattern on the rail as a result of the severe cant between the contact surface on this and the 1:40 and 1:30 cants.

There was slightly less wear on standard rail in Section 17 — that's the concrete tie section — than in Section 3, the wooden tie section. Again, this difference may be attributable to nonuniformity in railway and further analysis is required before we can compare the two directly.

With regard to ballast and subgrade, the results of analyses to date in concrete tie track as compared to wood tie track, shows the concrete tie track, even though it loads the subgrade to the same level as wood ties, deforms the ballast and subgrade to a greater extent than the wood tie. This is probably attributable to the loading mechanism of the concrete tie which appears to punch into the ballast. Whether or not this will continue to occur, will happen on existing rebuilt track or will occur with different ballast and subgrade materials is not known to date. As a result of this ballast gradation analysis, it is evident, however, that the concrete ties will initiate such gradation in a granite ballast where high impact loads are transmitted to the ballast because of a soft spot. Because of this implace on a soft spot, this reinforces the notion that the occurrence of rail corrugations or the use of rail plugs in concrete tie will lead to progressive deterioration of the track.

To date, there is little evidence of a trend in the performance of the different types of ballast or ballast depth at FAST. It is anticipated that later phases will provide more input into this area, but there is much data to be analyzed to date and we need more traffic before we can predict ballast under various conditions.

Before closing, I would like to just show a few of the mechanical tests. In this area, we just simply do not have enough mileage to permit really firm conclusions on a mechanical component performance. However, there have been some problems and a few trends can be observed.

A large number of wheels have experienced cracks in the flanges. These appear to be the result of thermal stress. With the help of several manufacturers and several laboratories, we have an extensive investigation going at present. Hopefully, we'll have results to publish in the near future.

A few wheels have also shown tread shelling. Again, at this point the cause is unknown. All we can say for sure is that the treated wheels are lasting longer than the untreated. So far there has been no significant difference, however, between the wrought and cast wheels. Again, as I say, we are on low mileage.

While the statistical evidence is limited, it appears that cars with 14-inch center plates are experiencing less wear than those with 16-inch center plates.

To summarize our experience to date, it shows that we are learning how to conduct these accelerated tests, learning how to collect the data, although we are having a little difficulty learning how to analyze it in a quick fashion. However, the specific results of individual components have been of value to industry and as we accumulate more mileage and tonnage we assume it will be of much more value to the industry. With the continued help of the AAR Technical Center here in Chicago, we hopefully will publish results just as quickly as the experimental data analysis permits.

Before I close, I should mention that plans are under way today for a larger FAST that will permit a broader range of testing. We hope to have large sections that will permit track investigations and its effect on the roadway. We in the FRA, as I mentioned earlier, are very excited about the FAST concept and hopefully will use more of this approach in our research. We feel in this way we can use federal assistance to help the industry help itself rather than interject too much government control in other types of assistance.

I personally believe FAST and those who follow it will become a way of life for those who are operating and supplying equipment for America's railroads. Hopefully, in a year I will have the opportunity to return and tell you of even more activities, not only on the current FAST, but what we are planning for the next phase.

Thank you very much. (Applause)

President Rankin: Mr. Parsons, thank you for the time and effort to inform us of the work carried on at the FAST track facility. We invite you to stay for any of our programs. We realize you have a schedule to maintain. Feel free to go as your schedule requires.

I now return the rostrum to President Cruse.

President Cruse: Has Mr. Dempsey arrived as yet?

If not, we will move on with our next speaker. At this time, I would like to introduce Mr. Tracy Kelly.

Mr. Kelly attended New Mexico Military Institute at Roswell, New Mexico, from 1942 to 1946. He attended Oklahoma University at Norman, Oklahoma, from 1946 to 1948. And he took Post Graduate work at Harvard from 1949 to 1950.

He served as 1st Lieutenant in the U.S. Army in the Korean campaign.

Mr. Kelly is President and Chairman of the Board of the American National Bank of Bristow, Oklahoma, and Chairman of the Board of Citizens State Bank, Okemah, Oklahoma.

He serves on the Advisory Council of the Small Business Association, Washington, D.C., and he is a director of several corporate boards in Oklahoma and Missouri.

He is also active in church work and in numerous civil organizations.

Mr. Kelly is well known throughout the southwest as being an evangelist on the subject of private enterprise.

I now introduce you to Mr. Tracy Kelly. (Applause)

Private Enterprise

By TRACY KELLY

President, American National Bank, Bristow, Oklahoma

Thank you very much, Bill Cruse, Mr. Rankin, distinguished officers, railroaders and guests:

I think, looking at this crowd on Monday morning, the two Presidents of these two illustrious Associations wanted me to remind you during the course of this convention a little couplet that goes like this:

"Early to bed
And early to rise;
Will keep the red
Out of the whites of your eyes."

You look like a pretty live group for Monday morning and I appreciate very much you being here to participate in these programs.

Well, Bill Cruse told you everything except the fact I have been circumcized. I've lived a quarter of a mile from Warren Rankin's track all my life. I'm working less than 200 yards from where I was born. That shows you what a meteoric rise I've had.

Tracy Kelly

I was in a saddle long before I was behind a desk at a bank. There are a lot of interesting things that happen in a bank, and, being kind of a cowboy banker, as you might detect a little later on in my language and presentation, I can be known to be pretty crude.

I've been in the cowboy business and in the banking business to the extent that I know the similarity between an irate customer and a wet saddle. They'll both chap your ass in five minutes!

You know, a lot of times in the banking business you must keep a sense of humor in order to just survive and I am sure that is true with you railroaders, roadmasters.

When I started in the banking business, we would loan money at 6% and pay 2% or 3% for savings accounts. And 6% was the going rate for all our cattle customers. And one day my boss called us all in and said, "We're going to have to raise this interest on these cattle loans from now on and it's not going to be 6% — we're going to move it to 8%. The cost of our money is going up, so, therefore, we're going to have to charge more money.

So, it fell my lot to talk to one of the crustiest old cowboy customers we had. He had been doing business for 25 to 30 years at our bank. I was a junior officer. And when I announced to him that these cattle loans were going to be 8%, he said, "But I've always paid 6%."

I said, "I know, but the cost of money is going up and it's going to be 8% from now on."

He said, "I don't believe you understand. I've always paid 6% at this bank, and now you want me to pay 8%."

I said, "That's correct. We're communicating."

He said, "What in hell happened to seven?"

Well, one more story about an old boy who came in. In a country bank we do a lot of things above and beyond just commercial banking, in spite of what Burt Lance does. But this old boy had his bookkeeping for the year on an envelope. On one side he had "Income." It showed what he got for the calves he sold, and what mamma got for the cream and the eggs. That was all income. And you turned the envelope over and it was labeled, "Outcome." So, from that you are supposed to come up with a tax report.

Well, gentlemen, I speculated a long time on what I might relate to you roadmasters and railroad people. And I have a great deal of respect for you and the job that you are doing in this country. I think the public generally takes railroads for granted. Your light is under a bushel.

You gentlemen in this room, and your counterparts at home, believe me, represent the delivery system for the finest railroad network in the world. And for that, I personally salute you and the job that you are doing in a very low key environment. If I had one admonition it would be, "Let your light shine a little brighter and flaunt it a bit." You railroaders, I think, are too modest with the performance that you are doing and the service that you are giving to this country. And I might hasten to add you can do it in the private sector so much better than you can do it in the public sector.

I was delighted to hear Mr. Parsons relate about the FAST track. Certainly private enterprise can do it a lot easier than turning it over to the sterility of government.

I'm reminded of the guy who said, "If the world's getting smaller, how come postage is going up?" The government can't run a post office. It's just not in their mentality to do it.

I'm reminded of the old roadmaster who was asked how many men he had working for him, and he said, "Oh — about half."

You gentlemen laugh so knowingly.

Well, needless to say I'm happy to be here and share some thoughts with you today. These are some preachments from a country banker who loves this country and its people more than I can express and I have devoted my life to try to upgrade the quality of performance of everybody in a private environment and not be subject to government control. I think the government can just about control everything but the federal budget at this time.

When you ask yourself, "In what time

of all of history, would you like to live? When would be the time you would most like to live?" Invariably the people respond, "This is the best time to live in my lifetime." We're blessed beyond measure. And I think we need to pause long enough to thank God for our living in this country during this time. We can be ever so critical, and, hopefully, it's constructive criticism, but we need to pause long enough to thank God for being in a free country.

If you would destroy all the passports of the world, make them null and void, guess which way the flow of humanity would come? To this great country. We have some magic here that we need to take inventory of so as to keep these values and not let them deteriorate into other systems.

We've come from a horse and buggy era into interplanetary travel in one lifetime. We've come from steam and wind power to nuclear energy. I think this is to be commended. But with all of these creature comforts and with all the endowments we have enjoyed, I want this morning, if we can, to say something about the vitality and the dynamism of the free enterprise system and how I view enlightened business as a major contributor to the public interest.

I think the private entrepreneur hasn't had his fair hearing. Gentlemen, before we are business men, before we are roadmasters, before we're parents, we are children of God—first. We're citizens in a free society. And because of that, gentlemen, we bear certain responsibilities. Not because you're railroaders or because you're white or black. You are first a child of God in a free society. And because of that we have certain responsibilities that must be met.

Aristotle said 2,000 years ago that men may differ but the salvation of the community is the business of us all. You gentlemen out there in this audience today, may differ on issues, on political candidates, on women, on football games, on whether the sewer line ought to go there or somewhere else. You may differ on the quality of rail. But the salvation of the community is the business of us all and that's where we need to be responsible citizens.

As enlightened business men and women, you are serving the public and because of where you are and the kind of business you are in, roadmasters, you can contribute more than most to the common business of us all. As management people you have a higher duty to contribute.

I'm interested in what kind of management, what kind of leaders you gentlemen are.

There is one element of our business system that is frequently misunderstood, and sometimes even apologized for. Yet it serves well and it serves the public and it helps immediately to build a better society. It delivers far more to the public every day than all the other public service of business put together. I'm referring to the profit motive.

How is your head screwed on this morning as far as making a profit for your company? The profit motive is one of the greatest instruments of public service ever devised. It merits much greater recognition for the public service it performs. Increasingly, it seems to me, we business men try to justify our companies by referring mainly to their good works in aiding education, in helping solve social problems, and in serving our communities in a great variety of ways. These things are important, of course. However, one cannot organize the economic activity of this nation based on solely altruistic goals, good works and volunteer public service. Too often, it seems to me, we shy away from talking about how dynamic a force the profit motive works to build the quality of life. We practice capitalism, yet we are reluctant to preach it. We cannot discharge our community responsibilities unless we make a profit. Gentlemen, without a profit, you don't have a job. That's how serious it is.

I am here today to champion profit. Don't apologize for it. Propagandize your work force. Propagandize does not mean sinister untruths. Profit is not unwarranted gain. Where do you think the money came from to put in the FAST track? From private industry. If you are waiting for an act of Congress, you're going to be waiting for a while. Private industry has to plow that money into research and development. This is the magic magic that we need to communicate to the troops. And you people in this room and your counterparts across this country are the people who do that. You have credibility. You have much more credibility than the glass-eyed banker coming down and telling them about profits.

As I said, profit is not unwarranted gain. Profit is that uncertain residual that goes to the owner after everything else is paid. Gentlemen, you take the profit out of the system and you have gutted it. I'm talking about the American system. Serving the public and seeking profit reinforce each other. They are mutually supporting. History shows that man owes his greatest material advantage to freedom. Destroy the freedom to make a profit and you destroy our greatest freedom.

That's how serious it is, gentlemen. You can't help anybody unless you can successfully take care of yourself. In our little bank we don't want to do business with anybody who doesn't want to make a profit. That's pretty harsh. That's what makes this system go, people. We have to champion it. This is why I get so disturbed when the government insists on legislating wages. Wages need to be negotiated, gentlemen, not legislated.

You see how twisted we are becoming. You people in the grass roots of the railroad systems of this country can do a lot to correct that deteriorated trend.

Those of us in business and commerce have failed, in my opinion, to get across the point it is the profit motivated private sector of the economy from which wages are earned, taxes are paid, investments are generated and from which the great contributions to educational and charitable government enterprises are made.

The government can't give you anything until it has extracted it from somebody else before it does. The government is us, people. Our failure to achieve an adequate level of economic literacy on the part of the American people has led the body politic to make unwise public decisions. In my judgment, perhaps the greatest problem in America today is the economic illiteracy of the electorate. We're a bunch of dummies when it comes to economic understanding of this profit motive. Otherwise, we would have a different complexion of Congress. It's a reflection of the people. We have no one to blame but ourselves, railroaders, and bankers. I become extremely disappointed with my banking fraternity when they lie behind the log and don't tell their market place, their public, what inflation does to their depositors' dollars.

The demagogues in this country, using the avenues of the public media, have convicted the oil companies and the railroads. They have convicted them in the headlines. What they are doing to energy right now, for example, and the divestiture of oil companies is simply the latest illustration of how easy it is to discredit the profit incentive, to impinge the motives of anybody who succeeds beyond mediocrity and to place under suspicion anyone who makes a profit. I don't like that, railroaders, and that's why I'm in Chicago this morning to get some more zealots in the system to champion the cause of profit and private enterprise.

Last fall, 69% of the people wanted controls of corporate profits to insure reasonable food prices. That means 7 out of 10 people do not have confidence that the incentives of economic systems will bring new business into the food industry. The most profoundly limiting factor in good government is the discouragingly low level of economic understanding. Our country prides itself and has become great in the concept that man succeeds by performance and not by circumstance of his birth. This is what made this country great.

In my little village, there is a gentleman who just two years ago won the Small Business Man Of The Year Award in Oklahoma. Ten years ago, he was mowing grass on the highway right-of-way. He could only make that meteoric rise in this country. Thank God for the system that lets that happen. He has a country sale barn now and he's doing great.

The point being, we need to preserve the system that allows this kind of performance. There are plenty of pressures in a democracy to move further in the direction of sharing rewards regardless of individual performance. And I don't like that. Share the wealth programs have considerable political appeal. Because of these pressures, one sees a growing tendency towards a philosophy that to each according to his needs and from each according to his abilities. There's nothing wrong with this philosophy, gentlemen, except it just won't work.

One of my favorite quotations is one that Churchill made. He said, "The inherent vice of capitalism is the unequal sharing of blessings. But the inherent vice of socialism is the equal sharing of miseries."

Gentlemen, don't put us all in a class with society. You can't turn the railroad over to some of your subordinates because they don't have the moxy to do your job. God made us different. Read the parable of the talents if you want to know about the difference in talents and in qualifications. Let's don't pour everybody in the same mold. You get emasculated that way. You get mediocre performance.

Let's don't scuttle the system that has created the standard of living that we have had. Never in the history of humanity, gentlemen, has so much been shared by so many as in this great country, in the private enterprise system.

Just an interesting little bit of trivia, perhaps, but an average man needs to work for six months in this country to get enough money to buy an automobile. In Russia, they would have to work for 42 months and still couldn't buy it.

You know, with all the international give-away, and so forth, I am reminded of what Will Rogers, one of our beloved Oklahoman's, said. He said, "These foreign countries never hate us so much that they don't quit using us." And so it goes with our continued supporting the world. I'm not knocking that except we need to support ourselves with the idea of being able to accumulate enough capital to ply it back into the companies to generate more jobs. The way you generate jobs is by creating a business climate that will enable you to want to expand and develop new technologies.

When I was in the first grade, one person out of 26 worked for the government. Today, one person in six works for the government. Our forefathers built a rich heritage for us, a legacy of love, industry and high courage, and our great American free enterprise system was not a gift from God but a rich inheritance painfully built by men. We show our gratefulness to those forefathers by honoring this heritage and by passing it on, strengthened and reinforced to those who shall come after us.

One of the over-riding tasks of our times is to inculcate our young people with a firm belief in our free enterprise system. We hardly can expect our system to survive for another generation if the coming generation does not believe in it. If our system survives, gentlemen, we desperately need their understanding and support.

I'm curious to wonder how the economic understanding is in your place of influence, in your shop, with your road crews. Do you have among your employees a bunch of rip-off artists? Employees who fake absenteeism, who fake injuries, that what you don't know won't hurt you, this kind of attitude? It's a matter of management leadership, gentlemen.

One of the most and more insidious criticisms of the profit motive is that it is capable of corrupting individuals and companies. Sure, it's capable of abuse. Because of this, society has set up laws and government regulatory agencies to guard against such abuse. And those of us in banking and railroading are painfully aware of these restrictions. The danger is that in order to restrain the corrupt few, the restrictions will gradually become so many, so burdensome, so harassing, that they will destroy the incentive system and deny our society the vast potential of the profit motive for genuine public service.

This is my opinion, the way I view the present posture of the mentality of this country. We think we can solve every problem by passing legislation. This is not true, gentlemen. It has to start with you where you are, bloom where you are planted, if you will.

With more and more government intervention, it is a continual mystery to me why the public is apparently more trustful of the motivations of people in government than it is the people in business. After all, those who enter the political or governmental area are frequently inspired by motives which are also capable of abuse. The desire for power, fame — the desire for headlines and favorable public image — are also capable of corrupting people. We've seen some spectacular examples of that recently. But they have been in our government and in our society long before today. It's in all governments, in all nations, in all history.

I am reminded of what Lincoln said. He was being criticized for a crooked and corrupt judiciary. He said, "Gentlemen, our judges are as honest as other people." He also said, "Folk with no vices have darned few virtues."

Let's be willing to make mistakes. Let's be willing to have confidence in our judgment and go ahead — act. We have a mentality in this country, gentlemen, it's "cover your fanny;" you know. "Protect your ass," in other words. And that's not right. Let's look at the spirit of the thing.

We are so gripped with class actions. Certainly, the whole mentality of this country is scared of liability. And I'm just naive enough to come in on a load of pumpkins from a small town in Oklahoma and say, "That ain't right." This country is mentally askewed when we are not performing the missions. We're too worried about liability. Because, we, the people, have allowed it to happen. You know, "Let the railroad pay! They've got the money!" That's wrong. And let's don't just waive it away and say, "Well, it's being done." Let's be stalwart enough to stand our ground, roadmasters.

Ultimately, the restraint against corruption, whether in government or in business, will depend upon the moral character and fiber of you and me, and therefore on the ethical and spiritual underpinning of our society and our culture.

There is no good or bad government —but only good and bad men. If your government has run afoul, it is not the fault of your government, for you will find it difficult to discover ways to improve your Constitution and its ability to prevent its officials from misusing their authority. Nay, the error is not in the Constitution. It is in those who have abused the public trust in violation of the Constitution. It is in those who have allowed them to continue in that abuse. If you see something going wrong on your railroad, you owe it to yourself, to your moral conscience, to discretely do something about it. Do not turn your head. This is happening every day in your system and in mine. You don't have to be pointing at the government. Clean up your own shop.

We need to encourage all of our people to strive for excellence, be loyal to their employer. If you cannot be loyal to your employer, for God's sakes get off his payroll. That's the least you can do. Be champions of your team. Don't tackle your own quarter back.

Another slothful attitude that disturbs me is the syndrome "It's good enough for whom it's for." How many of you are familiar with that kind of attitude? Fixing a tie or improving a bridge — "It's good enough for whom it's for."

There is some scriptural admonition that says, gentlemen, "Whatever your hands find to do, do it with all your might." As in serving the Lord — also in serving men.

Don't be half-hearted in your performance. If you're going out there to fix that road, get it fixed. That's the mission. With that attitude, I guarantee you that if you get generally interested and care about your men and people under your supervision and show concern for them, your roadmaster problems will be pretty well solved. It's that simple. Because you know and your life can be your message that you care about those people. You care about their well being. You are not interested in exploiting them. Because, you see, gentlemen, everybody is somebody. I don't care if they just did get on the system. I don't care if they do have two left hands. Everybody is somebody and needs to be treated that way. The sanctity and dignity of the individual is very important in our whole system.

During his entire ministery, Christ constantly concerned himself with the individual. He would leave a crowd to aid a person. He respected the individuality of each person and sought to make men realize how much value they were to themselves and to God.

Every person is important. The guy next to you is something very, very special. Because God made him. The people you have left back running your shop today are very important. There is no one like them in the entire world. They need to be treated that way — genuinely treated that way.

Well, I would like to leave you with a charge, gentlemen, to champion the cause of private enterprise and my prayer for each of you is that you will be willing to take some risks in relationships with people and not be so concerned about liability that you don't get the job done with people and with the company. And that you try every day to realize that everybody is somebody, and to strive for excellence and champion the cause of the private sector of this great country.

Best wishes to you in your continued convention sessions. Thank you. (Applause)

President Cruse: Mr. Kelly, I certainly wish to thank you for both of the Associations. Your address here today puts me in mind of the TV commercial where the fellow puts the little lotion on his face and then slaps his face and says, "I Needed That!" I would say we all needed what Mr. Kelly brought to us today.

Next, we will move on to our keynote speaker. Mr. Dempsey says they routed him to the wrong Hyatt House, out at O'Hare, so he had a little traffic problem getting back in here.

Mr. William H. Dempsey was graduated valedictorian from the University of Notre Dame in 1952. He received his Law degree in 1955, magna cum laude, from Yale Law School.

Mr. Dempsey served as Officer of the Yale Law Journal, Law Clerk to the U.S. Court of Appeals, District of Columbia Circuit, 1955-1956.

First Lieutenant, U.S. Army, Judge Advocate General's Corps, 1956-1959.

He was on special assignment to the Office of the General Counsel of the Army in 1957, and Chief Law Clerk to Chief Justice Earl Warren of the Supreme Court of the United States, 1959-1960.

He joined the firm of Shay and Gardner in 1962 and practiced federal law and law litigation, including a large amount of railway labor litigation.

In addition to Mr. Dempsey's long list of achievements, he is a member of the District of Columbia Bar Association and the Federal Bar Association.

He was Chairman of the National Railway Labor Conference in 1962 to March 31, 1977. On April 1, 1977, he was appointed President and Executive Officer of the Association of American Railroads. Mr. William H. Dempsey. (Applause)

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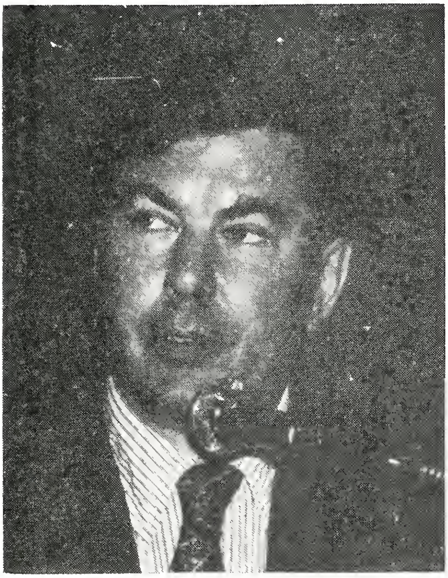
Keynote Address

By W. H. DEMPSEY

President and Chief Executive Officer, Association of American Railroads, Washington, D.C.



W. H. Dempsey

Thank you very much. I apologize for being late, but in a way I reflected on my way out here after I finally got on the right track that it kind of serves you right. You invited somebody from Washington and about 50% of the time, even though we start out right, we wind up in the wrong place.

Mr. Kelly, there is another thing about Washingtonians — even when we're wrong, we're very reluctant to admit it. So I wandered around out there for a while. I almost spoke to one of your organizations. The American Bankers' Association is meeting out there. I thought perhaps it must be this group, until I saw the black crepe hanging and people muttering about compensating balances, phony collateral, and things of that sort. So I decided I should betake myself some place else.

I left Washington this morning in heavy fog, and I thought to myself as I landed here on this beautiful, clear day that nature does in a way reflect reality. I've been in Washington for 22 years now. I was raised in the Middle West. And for about 22 years I've been in a fog, more or less. I finally decided the more or the less depended upon whether Congress was in session or in recess.

It's a strange city in many, many ways — an artificial one. The subject that I was asked to talk to you about today has to do in a way with how the railroad industry manages to survive through all the politicking down in that city. It isn't easy. It puts me in mind of one of my favorite stories about a Senator who in the course of a long career finally became Chairman of the Senate Interior Committee and he decided he ought to take himself out and meet some of his constituents.

He went out to Arizona to visit an Indian Reservation. They brought the members of the tribe in so he could say a few words to them. After making a few preliminary remarks, he thought of his mission, and he said, "You know, I've looked around here and I see that your old people don't really have any place to get together. I want to tell you, now that I'm Chairman of the Senate Interior Committee, I'm going to see that a new facility will be built for them here. I think maybe over on that yonder hill would be a nice place. It's going to be the finest recreation facility for old people on any Indian Reservation."

A few scattered shouts of "Hoya" were heard out in the audience. He was a little startled. He had never heard anything like that before.

But he went on. He said, "I notice you don't have a doctor on the Reservation. You have got to bring one in from 50 miles away. Now that isn't right. Now that I'm Chairman of the Senate Interior Committee, I'm going to bring a team of doctors and nurses in here and I want you to know they will be well trained. As a matter of fact they are going to be the best doctors and nurses in the whole state."

At this point more and louder shouts of "Hoya" came from the audience. He became quite encouraged. He thought this quite plainly was a means the Indians used to urge him on.

So, he said, "Those doctors and nurses are going to have to have a place to practice and so I'm going to, now that I'm Chairman of the Senate Interior Committee, see that there is a brand new hospital here. I'll just put it on that hill, over there opposite that recreation hall. It's going to be the finest hospital in the whole west."

And at this point louder cries of "Hoya" were heard. He thought this was just about the warmest reception he had ever gotten. With a tear trickling down his cheek, he said, "Now, just before I leave you, I just want to leave you with this final thought. All of us in Washington love you, and we're all your friends, and you can trust us."

With that, the shouts of "Hoya" rose up and the rafters shook.

Then he went out with the Chief on a tour of the Reservation. He said, "Chief, over on that hill, looks like an awfully fine herd of cattle. I wonder if I could just walk across there to see them."

The Chief said, "Why, of course, Senator. Just watch out you don't step in the Hoya!"

I have a text here but, I'm so unnerved by my experience this morning I don't think I will really read it. Besides that, there are certain hazards associated with a prepared text.

Joe Califano, the Secretary of Health, Education and Welfare, used to be Domestic Adviser to President Johnson, and he has a wonderful story he tells every once in a while about that.

When he was Domestic Adviser, he had, he said, the distinction of firing a speech writer named Peter Benchley. Peter Benchley, as you doubtless know, is the author of "Jaws." Joe fired him because he thought he couldn't write. He said Benchley got his revenge. Joe told him he was through in the morning, but Benchley still had one task to discharge. The President frequently gave little talks that were known in the White House as "Rose Garden Talks" because they would typically be given in the Rose Garden by some group of Legionnaires, or Boy Scouts, or Camp Fire Girls, or something of that sort. The President would never read the speeches before hand. They would be prepared for him on big cards and he would just flip the cards over.

Eventually, as his last chore at the White House, he wrote this Rose Garden Speech for whatever group it happened to be. President Johnson got out there and started up with a few introductory remarks and, "Now," he said, "they say that we can't have both guns and butter, but I say that we can and I'm going to tell you how."

"Now, they say we can't have national health insurance without crushing taxes, but," he said, "I say that we can and I'm going to tell you how"

"They say we can't have peace in Viet Nam without honor, but I say that we can, and I'm going to tell you how."

"And now, Lyndon, you're on your own." (Laughter)

Well, let me spend just a few minutes with you. I'll turn these pages every once in a while so that you will know that appropriate progress is being made. If anybody wants to know how it all came out, I'll stop and you can come up and get a copy at the end of the speech.

I'll just take my watch off here so I don't ramble on too long.

Two legislative items on agenda

Let me begin by just making a few remarks about two of the principal legislative items that we have on our agenda down in Washington.

Locks and Dam 26

The first is Locks and Dam 26. I'm sure you have all heard about it. What is involved here is the effort by the barge industry and the Corps of Engineers initially to spend, oh, in excess of $400 million on constructing a new lock and a new dam at Alton, Illinois, a pivotal point for barge traffic on the river.

What has become enmeshed in this whole controversy is the question of user charges to the barge industry. I don't want to say very much about Locks and Dam 26 except that in my opinion it is a major rip-off of the American taxpayer. I think our expert testimony quite clearly establishes that the lock and dam could be rehabilitated at a cost of $25 million, saving the American taxpayer something in the way of $400 million. And even if one wanted to put a new 1200 foot lock in there, (which I don't think is necessary), you could do that on the old dam at a cost of about $200 million. So, in anybody's terms, we're wasting a minimum of $200 million if that lock and dam is authorized.

Now the reason that people don't seem to stumble very much over that sort of thing in Washington is that it is almost regarded as free—free money.

They talk about a bottleneck on the waterway. And I say to them, "You know, we have a lot of bottlenecks. We call them 'old yards.' I could rebuild ten of those and put in brand new automated hump yards at a cost of one Alton Dam No. 26, but no one offers me $400 million without turning around just because we say there is a bottleneck in the rail distribution system."

The fact of the matter is, that's the way the money has been pumped into the construction and maintenance and operation of the American waterway system now for decades and decades. Somebody gave some private in the Corps of Engineers a shovel back at the Battle of Bunker Hill and we have been in trouble ever since. They're going to make Salt Lake City a deep water port pretty soon.

Waterways pay nothing for right-of-way

In any event, my main point here is not so much Lock and Dam 26, but the question of the inequity of having one major competitor, one major mode of transportation, pay nothing for its right-of-way. Rather, have that right-of-way given to it by the American taxpayer, when competing modes are in quite a different situation.

Railroads own right-of-way

The railroads, of course, as you all know, you of all people, not only own their right-of-way, but we maintain it and we pay taxes on it.

Highways do not own right-of-way

Now, the highway industry doesn't own its right-of-way and it doesn't pay taxes on it, and to that extent it has an advantage over us. But the principle is established that the highway industry is supposed to pay user charges, that it will pay its fair share of the American highway system. We don't think that in practice the figures are right. We think in point of fact the highway industry is not paying its fair share. We think the studies that are outstanding so indicate. But at least the principle is established of fair and equitable user charges. But not for the barge industry. The barge industry has never paid a nickel — a nickel — for its right-of-way. And the subsidy that it gets is just absolutely astronomical.

Railroads cannot compete

To give you an idea of the order of magnitude I'm talking about here, the Congressional Budget Office calculates that for every dollar, for every dollar that a shipper by water pays in tariff to the barge industry, the federal government pays the barge industry 42¢ in the way of construction, operation and maintenance of the inland waterway system. If we had that kind of subsidy, it would amount to, oh, roughly $8 billion a year.

Now, obviously we can't compete effectively with competitors who receive that kind of underwriting by the federal government. The railroads suffer. Those shippers and communities that depend upon rail, and they are in the vast majority, suffer, and the American taxpayer suffers. Yet, although every Administration since Franklin Delano Roosevelt has recommended the establishment of a fair system of user charges, until today no bill has ever survived in the Congress of the United States. Now, today, it appears that one will. Our legislative situation right now is rather complicated but let me try to indicate about what it comes to.

Bill asks for user charges

The Senate has passed a bill that would authorize a new Lock and Dam 26 at Alton, and it would also establish a system of user charges that would recapture 100% of money spent to operate and maintain the inland waterway system for the benefit of the barge lines and 50% of the cost of new construction on the inland waterways. It ought to be 100%, but 50% is a pretty good start. Those charges are to be phased in over a long period of time — 10 years — longer than I think is necessary for anyone to make any adjustments here, but, in any event, as I say, that is a major improvement over what we have at the present time.

The House is a much more difficult forum for us. In the House, two committees with jurisdiction have now reported out a bill that is ready for consideration by the full House. It also provides for the construction of the new Lock and Dam at Alton. But as far as user charges are concerned, it provides for a 4¢ a gallon tax on diesel fuel to begin with, escallating to 6¢ in the following year. And a study is to be made of the impact of this kind of user charge and a report made back to the Congress.

Now this is a transparently trivial tax. It would recover only approximately 9% of the monies that the taxpayers now spend on behalf of the barge system. Our hope is that when it goes to the Senate, the Senate will re-enact the version that it has already enacted, and that when the two Houses go to conference over these, then conflicting versions of user charges, something will emerge that is closer to the Senate bill than to the House bill. But, of course, no one can predict with any certitude at all what the final outcome will be. At least, one can say, though, that there is an increasing recognition in the Congress that the principle of equal competition ought to become more live in the transportation community than it has been to date.

Coal slurry pipe lines

Our second major legislative battle has to do with coal slurry pipelines. Here we face difficult problems. There is sort of a public entrancement with things that sound like major technological innovations. Coal slurry pipelines sound like it, although indeed they are not. They have been practicable from a technical point of view for many, many years. We have sent lots of things through pipelines. We stop short of people or anything like that, but we have sent lots of minerals.

What the coal slurry pipeline promoters need is federal legislation that will give them the right of eminent domain so that they will be able to get the right-of-way for their pipelines. Now the railroads have not been willing to let them cross their tracks but the pipeline promoters would not be satisfied with a bill that would simply give them the right to condemn railroad property rights. They need the right, as well, to condemn the property rights of many, many thousands of land owners whose land will be appropriated for these pipelines if they are going to be in existence.

Now the public sort of has the image, I think, or some of them at least, of the railroad sitting astride its track and refusing to let this new technological development come into fruition. What I have to say about that is that essentially our position is taken from a narrow point of view, if you will, but that from a public interest point of view it is sound.

Let me indicate one or two of the principal considerations that seem to us to be relevant.

Pipelines use much water

First of all, there is the problem of water, and it is a very, very serious one, indeed. Coal slurry pipelines gobble up enormous quantities of water. One ton of water for every ton of coal. And unhappily for the promoters of coal slurry pipelines, the coal is where the water is not. I'm talking, of course, about states like Montana, Wyoming and Colorado. That is why the coal slurry pipeline proposals have generated such intense opposition in those states by agricultural interests, as well as Senators and Representatives from those states. That's one major obstacle to the transportation of coal by rail, which is in that respect much more environmentally benign.

No evidence cheaper

Secondly, there is no credible evidence that these pipelines would transport the coal any more cheaply than railroads. The cost estimates of the coal slurry pipeline proponents are 1973 cost estimates, and anyone has the right to be legitimately skeptical about any pipeline cost after the Alyesco experience in which the cost of that pipeline escalated from about one billion to about eight billion in about eight years.

Impact on present modes of transportation

Finally — finally — there is the question of impact on competing modes of transportation, principally the railroads. Because, as you all know, what we have in the railroad industry is enormous excess capacity. We are transporting only about 50% — only about 50% — as many ton miles per mile of track now as we were at the end of the 2nd World War. What that means, in other terms, is an enormous investment in capital. In order to cover that investment, we need more and more traffic.

Now coal, as the most important bridge fuel under the President's energy program, provides the promise of that additional traffic. Particularly is that so for the railroads in the Middle West that have been marginal and that have not been important movers of coal in the past. I'm talking about roads like the Rock Island, which is in its reorganization now, the North Western, the Chicago & Milwaukee, that would become major movers of coal under the energy program, provided that coal is not all siphoned away by coal slurry pipelines.

Now, the important consideration here, it seems to me, is that what we're dealing with is not really fair competition. Coal slurry pipelines are not designed to be common carriers. Because of their nature, they cannot be. They can serve only huge consumers. In order to be economical at all, they must provide delivery of about 25 million tons of coal a year. That's an enormous amount of coal — 25 million tons a year. So, what they are looking to are major sources of supply and major consumers at the other end of the line.

Unit train better answer

Now, of course, this is exactly the kind of movement that is the best of all in terms of rail traffic. It is the kind of movement that could be handled and it would be largely in the Middle West, the Middle West and the Southwest. It is the kind of coal that can be handled in unit trains, the best kind of delivery service and the most economical from our point of view.

So, let me add this. The coal slurry pipeline promoters say they must have the right to lock up those markets with 25 to 30-year contracts — what they call "true put" contracts. The shipper obligates himself to provide 25 to 30-

million tons of coal a year whether or not he ships it. He has to pay for it. What that means is that 25 million tons for every coal slurry pipeline would be taken out of competition, no matter what the railroads did in terms of improved service, reduced rates, improved productivity. All that on the cream of the traffic. Leaving who, then, to serve everyone else? The railroads. They are the only common carriers left who are able to supply the relatively small producer, the relatively small consumer, the many, many industries that will now have to convert to coal under the coal conversion program and who couldn't possibly benefit from coal slurry pipelines.

What happens then is that this opportunity to increase our traffic, to spread our fixed cost out over more and more units of production to the benefit of all the shippers in the United States would be sacrificed to the benefit of the coal slurry pipelines and the few shippers and the few producers who would be large enough to benefit from this kind of enterprise.

Well, where are we? So far, we have been successful. There have not been hearings during this session in the Senate. In the House, there have been hearings, but the committees voted to postpone consideration until after the first of the year, but by a very narrow margin, as narrow as it could be, one vote.

This may not last. The committees have on their calendar a motion to reconsider that I believe is coming up next week — yes, next week. So, we just don't know yet and have no basis for predicting how this fight may wind up in the Congress. But I want to say to you that it is of enormous consequence to the railroad industry. I think you should know that and I think that all the people who work under you should know that.

Public becoming aware of problems

I think it is true that five years ago — six to ten years ago — we would not be as successful as we have been in the user charge controversy and to date in the coal slurry controversy because it has only been in the last few years that there has been a new sense in the Congress, and I think in the public in general, a new awareness of the kind of problems that our industry confronts.

You know, it has been a bad 20 years for our industry. You all know that. I think you have to be born again in Washington these days and I am hopeful we will qualify because I think there is a real chance that our industry will be born again. There is a renewed sense of optimism that I see in board meetings and meetings of all sorts which is in contrast to a sense of almost despair that many people felt over the last 20 years, as we saw our share of the market drop and drop and drop.

Nationalization a disaster

It has not been, I should note, a problem that has been confined to the railroad industry in the United States. This trouble that has afflicted the rail enterprise has afflicted the rail enterprise world-wide. Other countries, and I would like to dovetail my remarks with the kind of things Mr. Kelly was talking about, other countries, almost without exception, have turned to nationalization as the solution. Well, I think the evidence is pretty much in on that now and I think its message is pretty clear. Nationalization has been a disaster. Let me just give you a couple of figures.

I'll just take 1975. It is a representative and a recent year. In 1975, West Germany's nationalized railroad lost more than $4 billion. The Japanese National Railways, which are often held up as a model of excellence, lost $3.7 billion. The French, $3.4 billion. The Italians, $2.4 billion. And the British Railways, $818 million. That is a combined loss of more than $14 billion on revenues of $24 billion in one year. If we were to lose money at that rate, our loss here would have been $9.6 billion in one year alone.

Now, we made some money that year.

We didn't make very much. It was the depth of the worst recession that this country has seen since the 1930's. But we did turn, as an industry, a modest profit.

As I say, these figures are representative. I'll just take the five years ending in 1975. These are the most recent figures we have available. In these countries that I have mentioned, countries that in many respects are very much like ours, the nationalized railroads all together lost nearly $50 billion. And during that same 5-year period, we didn't make enough but we made something — we made about $3 billion.

Now, this is a calamity for these nations and they have responded to it finally as you might expect, with proposals for drastic cutbacks in service and in personnel. The French government, for example, is proposing a two-thirds cutback of its rail system and a 40% to 50% reduction in personnel over the next 15 years.

The Germans, a third cutback in trackage and personnel by 1985. Some 135,000 jobs are slated to be eliminated.

British Rails, if it has its way, only a little more than a half of the British Rail Systems will survive.

By 1980 the Japanese hope to eliminate some 50,000 jobs.

Now, I suggest that the message of all that, as I say, is perfectly clear. Nationalization is not a solution. All that happens is that the troubles that have beset the railroad industry are transferred from the private sector to the public sector and eventually even the resources of the central government become too slim to patch over these problems by subsidies. And then comes the crunch, when the service is cut back and the jobs are cut.

Railroad legislation easing

We have had some good fortune out of the Penn-Central collapse, which certain marks the nadir of American railroading. But as some good comes out of everything, some good came out of that. The public and Congress, as I say, became, I think, aware of the problems that we have faced. And the Quad-R Act of last year could be the most important piece of legislation in the last 50 years. I think its principal benefit is the purpose of easing up on the regulation of railroads.

You all know that the Interstate Commerce Act was passed at the end of the last century at a time when the railroads had a monopoly. The Interstate Commerce Commission was brought into play and since then we have been regulated as if we had a monopoly, when for at least the last 20 or 30 years it has been far from the case, as any realistic observer of the transportation scene knows.

Our most important competitors have been free of regulations. Ninety per cent of the barge traffic that we compete with is absolutely unregulated. Fifty per cent of the motor carrier traffic that we compete with, the most important part, private carriage and unregulated, compete in an environment in which they are free to respond immediately to the demands of the marketplace and we're strangled — we're strangled like a Goliath in this web of taut and tangled regulations. While the Quad-R Act offers the promise that some of that webbing will be cut, I can't say I'm terribly encouraged yet by the interpretations that have been given to the Act by the Interstate Commerce Commission. We are hopeful under new leadership that commission may take a different attitude, and in any case, key members of Congress have made it perfectly clear that they are keeping an eye on the situation and if the Interstate Commerce Commission thwarts the purpose of the Congress as reflected in that Act, that Congress will take renewed action.

We have these twin problems of regulation and of subsidies to competing modes that reflect the kinds of public policies that must be changed if this industry is to play its proper role in the transportation scene.

Railroads trying to improve operations

We're trying, goodness knows, to invest a great deal more in capital improvements. For the first six months of this year, for example, our capital expenditures have been up 29% over last year. Our cash expenditures for maintenance-of-way up, as you all know, about 22%. We're terribly serious about improving operations where we can, where we have enough money. One of the most important areas is maintenance-of-way employment. You know that employment is up sharply. Since July, 1975, through July of 1977, maintenance-of-way personnel has increased 19.7%. From nearly 84,000 people in 1975, to nearly 101,000 in 1977. This is 20% of our total work force. This compares with about 16.6% a few years earlier. But our problem, and Mr. Kelly put his finger on it, our problem is that we simply don't have enough capital to make the kinds of improvements that are necessary to provide our shippers with the kinds of service they are entitled to.

Profits going down

Our traffic is up modestly this year but it is still below pre-recession levels. We're spending a lot of money, the shippers are using us more but the fact is that our profits are going down. We haven't had as much as a 4% rate of return on capital investment in this industry since the 1950's. We haven't had as much as a 3% since the 1960's.

Last year, our rate of return, combined Class I railroads, was just about 1.5%. We are consistently at the bottom of the ladder of major American industries as far as return on investment is concerned. And with that kind of a problem, you just can't survive forever. What we have is a classic case of cash flow erosion. We're spending more than we're taking in. We have somehow to be able to raise the capital funds that we need and surely, at least two of the things that are necessary to put us into that kind of climate are the kinds of things that I have been talking about. They must put us in a fair competitive relationship with other modes of transportation.

Railroads do not ask for preferences

We don't ask for preferences. All that we ask for is parity. We just want to be able to compete in the marketplace on the same terms on which they are able to compete.

That I see some hope, is, I think, the kind of message that I would like to leave with you. I think there is a changing environment in Washington. Maybe by the next time you invite me the fog will have lifted and I will even get here on time.

Just before I close, I do want to supplement that little story Mr. Kelly told you about the fellow who said his workers worked about half. It reminded me of another story. And I assure you it has nothing to do with the railroad industry.

This is a story of a work crew that went out. They got out to the work site and lo and behold, they had forgotten their shovels. So the foreman called back to the supervisor, and he said, "Here we are, John, and we don't have any shovels on the truck."

The supervisor said, "Well, Joe, that's all right. Don't worry about it. I'll send a truck out with some more shovels — and until it gets there, just tell the men they should lean on one another."

Thanks a lot. (Applause)

President Cruse: Thank you, Mr. Dempsey, for taking the time to address our Associations today, and for your message, which was so timely and of utmost importance to the railroad industry and the country as a whole. I hope you gentlemen will take that message back to your own railroads.

We would like to have you stay for as much of the program as you care to. However, we know you have a busy schedule and you feel free to leave whenever you wish.

We have an announcement from the registration desk and as of this morning we have a total of 449 registered.

The Roadmasters will meet in this room and the Bridge & Building in Regency "B" at 1:30 sharp.

Mr. Rankin, have you anything further to add? If not, we will stand adjourned until 1:30.

. . . Recessed at 11:35 A.M. . . .

President's Address

By WARREN H. RANKIN

Senior Structural Engineer, SL-SF, Springfield, Mo.

Warren H. Rankin

The Monday afternoon session, Sept. 26, 1977 was called to order at 1:30 by President Warren H. Rankin.

With pleasure I call to order this 82nd Annual Convention of the American Railway Bridge & Building Association. Visitors, guests, and those attending for the first time are especially welcomed. The ladies are also most cordially invited to attend any of the sessions of interest to them, and to participate in the special program arranged for them.

As required by the by-laws of our constitution it is my duty to report to you the general condition of our association.

Treasurer W. H. Huffman's detailed financial report to be presented at the business session on Wednesday morning will reveal a sound, healthy financial condition. Funds not required for current operating expenses have been invested in interest bearing securities. This condition exists primarily through the sale of advertising in our proceedings publication. A professional advertising agency has produced this favorable situation for us. Your support of those who advertise is suggested for consideration. In the face of increasing costs we have been able to maintain our yearly membership dues at $7.00.

Our membership was at the 700 level as of June 1. Of this number 266, or 38%, were in the status of Associate, Life, or Honorary members. As Life and Honorary membership usually indicates a retired status, the need for attracting younger employees in our industry is apparent. Those of you who are in a position to do so are urged to acquaint your supervisors with the benefits of membership in the B&B Association and encourage them to apply for membership. To those who have fewer employees to do the same or more work, the value of becoming knowledgeable about their duties is paramount. Participation in the work of committee reports and attendance in the sessions at this convention is an excellent manner to acquire such knowledge.

Through the efforts of members of the Executive Committee, and with an alarming few individuals serving as chairmen or special subject committeemen, we still believe an interesting and informative program has been developed. Only the names of those committee members responding to the chairman's inquiry or work assignment will appear in the Proceedings. In some instances it is almost a one man show. Shortly after this convention you will receive a card requesting your interest in special subjects to be developed, along with an indication of your willingness to participate in the preparation of reports which have been selected by the Executive Committee from a list of previous interest requests. Think seriously about this matter and actively participate in the work if you indicate the willingness to do so. The effort by a small number will not be representative of our membership and imposes an excessive burden on a few. Should our response remain at the same level, we will in time be forced to rely on addresses by specialists in the scope of the reports. The inherent cost of expenses and honorariums for such a program would have to be borne by our Association. Your comment or suggestion for activity of your Association for membership and attendance improvement, to your Executive Committee, is invited. Changes in a changing time may be appropriate to improve our organization.

Executive committee introduced

At this time I would like to introduce to you the members of your current Executive Committee. Please stand as your name is called — withhold your applause until all have been introduced. Beginning at my extreme right, our three Junior Directors are:

Mr. J. Budzileni, assistant to the bridge engineer Chicago, Rock Island and Pacific R.R., Chicago, Illinois who serves on our Ladies Entertainment, Membership, and Hotel Arrangement Committees. He also is the sponsor of Special Subject Report on the Maintenance of Branch Line Bridges.

Mr. B. J. King, bridge engineer, Coast Lines, Atchison, Topeka & Santa Fe R.R., Los Angeles, Calif. He is the chairman of our Advertising Committee and serves on the Necrology Committee. He also is sponsor of the Special Subject Report on replacing or making heavy repair to bridges having continuous welded rail.

Mr. J. G. Robertson, manager engineering design, Bessemer & Lake Erie R.R., Greenville, Pa. who serves on our Advertising and Special Subjects Committees and is sponsor on the Special Report on effect of unit train operation on bridges.

Our Intermediate Directors are:

Mr. W. J. Gunkle, senior structural inspector, ConRail, Philadelphia, Pa. He is chairman of our Necrology Committee and serves on the Registration Committee.

Mr. W. E. Halley, manager fire prevention, Chicago & North Western R.R., Chicago, Illinois. He is chairman of our Ladies Entertainment Committee and serves as a Joint Association Representative.

Mr. K. L. Wammel, assistant division engineer, Southern Pacific R.R., Portland, Oregon. He is chairman of our Resolutions Committee and serves on the Registration Committee.

Our Senior Directors are:

Mr. M. Noyszewski, bridge engineer, I.C.-Gulf R.R., Chicago, Ill. He is chairman of our Special Features and serves on the Public Relations and Convention Greetings Committee.

Mr. J. W. Chambers, bridge construction engineer, Missouri, Pacific R.R., St. Louis, MO. He is chairman of our Registration Committee and serves on our Special Subjects Committee.

Officers serving during the past year are:

First Vice President — Mr. J. R. Iwinski, assistant chief engineer-structures, Chicago & Northwestern R.R., Chicago. Jerry is the chairman of our Program and Special Subjects Committees and serves on our Standing Committee.

Second Vice President, Mr. W. C. Sturm, senior project engineer, Elgin, Joliet, and Eastern R.R., Joliet, Illinois. Wally is chairman of our Hotel Arrangements and Public Relations & Convention Greetings Committees. He also serves on our Publications and Standing Committees. He is the sponsor of Special Subject Report on Buildings.

Third Vice President — Mr. D. C. Gould, assistant structural engineer, Union Pacific R.R., Omaha, Nebraska. Don is chairman of our Membership Committee and serves on our Standing Committee.

Mr. J. R. Williams, engineer bridges, Chicago, Rock Island & Pacific R.R., our immediate past president has continued to serve our Association. Jack has served as chairman of our Nominating and Standing Committees.

Mr. W. H. Huffman, retired assistant vice president and chief engineer, Chicago & Northwestern R.R., Wilmette, Illinois. "Heinie" is our treasurer and also one of our esteemed past presidents.

Mrs. Ann Wilson, our secretary, is unable to be with us at this time because of duties at the registration desk. She will be with us at our business session on Wednesday morning. Speaking in behalf of all officers, directors, and past presidents, I can assure you we would be lost without our secretary who handles the assorted details to maintain our operation in continuity year after year. You may now applaud this fine group. (Applause)

Thank you, gentlemen, you may now be seated.

Tribute to Bob Dove

At this time I would like to call attention to the outstanding service of one of our long time members. He has served us in many capacities for the past 43 years. He served as our president in 1941. He was elevated to Honorary Membership in 1965. For many years he has been the guiding leadership in the publication of our Proceedings. We express our thanks for his many years of dedicated service to us. A special thank you from each to Bob Dove would be appropriate.

Term as president, Privilege and a pleasure

It has been my privilege and pleasure to have served you the past year as President and for several previous years as a director or committee chairman. It has been an informative and rewarding experience for me. The knowledge gained in participation along with the friendships developed with others in the industry has been a pleasure and satisfaction to me. It is my intent to continue to serve the Association in any way that I can in years to come and encourage you to do likewise.

We now enter that portion of our program which represents the effort of various members involved in preparation of reports on Special Subjects. Following the presentation of the report, your are invited to participate in discussion and ask questions. These reports will be published in our Proceedings. Some copies have been pre-printed and are available at the rostrum for those who desire them. I now call on Mr. Iwinski, chairman of our Special Subjects Committee, to introduce the Sponsor, who will coordinate any discussion after report is presented.

Mr. Iwinski: The Sponsor for the Special Report on "Replacing or Making Heavy Repairs to Bridges Having Continuous Welded Rail" — is Mr. B. J. King. Will he please come forward to present the chairman.

Mr. King: Chairman of this report is Mr. W. W. Haines, B&B Supervisor, Union Pacific Railroad, Portland, Oregon. Those assisting in the preparation of the report included Committee Members.

Mr. Haines will now present this report.

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Replacing or Making Heavy Repairs to Bridges Having Continuous Welded Rail

SPECIAL SUBJECT COMMITTEE NO. 1

COMMITTEE—W. W. HAINES, *Chairman*, B&B supervisor, UP, Portland, Oregon; R. K. WORDEN, *Vice Chairman*, general foreman, Santa Fe, Fort Worth, Texas; D. R. BRECHMANN, asst. general foreman, B&B & WS, Santa Fe, Fresno, Ca.; N. D. BRYANT, bridge engineer-construction, SL/SF, Springfield, Mo.; A. CLARK, mgr. structures, C&NW, Boone, Iowa; J. W. DAVIDSON, asst. director, bridge engineering, BN, St. Paul, Minnesota; R. E. FRAME, director rehabilitation & capital planning, ConRail, Phila., Pa.; J. F. SCHMITZ, B&B superintendent, MP, N. Little Rock, Ark.

First, let us speak a little about CWR or Continuous Welded Rail. CWR has been with us for some time now and will continue to be used more in the future. With the old CWR from main line trackage being utilized on branches and yard trackage, it therefore follows that the Bridge Departments must become well informed as to the effects CWR has in all fields of bridge repairs. When there is to be a CWR relay program, prior and during distribution, the B&B Supervisor and Track Supervisor should coordinate their efforts to see that the CWR strings are properly distributed up to and over bridges. When unloading CWR across open deck bridges without footwalks, the rail should be placed on top of the ties and on the outside of the timber guard rail with the rail being spiked to the backwall ties at each end. Where bridges are 40 ft. or more in length and when there are multiple spans, adequate support must be provided for the rail strings to prevent kinking or overturning, and securely fastened to prevent the rail from being dislodged by dragging equipment.

With the exception of ballast deck bridges, the railroads have various criteria governing the length of open deck bridges over which CWR will or will not be laid. Some lay CWR on all bridges regardless of the length, some restrict CWR on bridges of 200 feet or more in length, while others restrict CWR on open deck bridges of 300 feet or more in length. Bolted rail no longer than 78 feet in length is used on these bridges and off each end of the bridge approach for at least 195 feet, with this 195 feet of rail being securely anchored, boxing in each tie. Some do not use rail anchors on open deck bridges. On bridges that CWR is to be laid over, care should be taken to see that the rail strings are unloaded so that the joints will not be on or within 195 feet of the end of a bridge, thus providing full anchor protection.

Expansion and contraction being a critical factor with CWR, the method by which it is controlled varies within the railroad industry. It may be well to distinguish between two of the general approaches of anchoring CWR.

One approach has been to anchor the string of CWR at midpoint only with each end free to expand and contract. This type of installation requires the use of an expansion device at the ends of the strings. As long as the expansion joint is functioning properly, no locked stress will be in the rail.

The other approach is to anchor the CWR on the embankment well beyond the ends of the bridge. As a result, locked-in stress will be in the rail. Compression at high temperature and tension at low temperature. In addition, on curves, considerable side thrust will be on a bridge, both to the outside and to the inside of the curve. The amount of side thrust will vary depending on the degree of curvature and the amount of rail temperature variance from the temperature at which the rail was laid.

The Union Pacific uses the latter

method, but with rigid controls. Our Chief Engineer, Mr. R. M. Brown, has compiled a record of ambient temperatures, listing the mean averages and the extreme highs and lows from numerous locations on the system. From this, instructions are issued with each relay program, stating at what control temperature the rail strings are to be laid. With this controlled temperature and our rail anchoring system, the expansion and contraction is minimized as much as possible.

Now, let us go on to the repair and replacement of bridges with CWR.

The first and most important items that must be considered when working bridges with CWR are:

1. What was the temperature at which this rail was laid?
2. Has the rail been adjusted since it was laid?

These two items are a matter of record and this information should be readily available at a Division level. Before starting any work on a bridge, the foreman in charge must have this information, along with a rail thermometer so that he can safely proceed with his work. In scheduling major bridge work, it should not conflict with major track programs in the same area. There may be some cases where you can work a bridge in conjunction with track programs, but as a general rule this is not very feasible. With the rail temperature being the critical factor, anv work to be done on the bridge should be done with the temperature of the rail as close to that as when it was laid or on the lower side of this range.

Deck tie replacements

Deck tie replacements can be accomplished by leaving the alternate line or bolt tie in place with a loose bolt in it to hold alignment. The deck should be jacked up just the minimum amount to allow the removal and replacement of the other ties. Working in short segments of 15 to 20 feet and replacing that alternate tie as soon as the new ties have been spiked up and had line bolts placed in them. The lineal feet of track working area, of course, will be governed again by the rail temperature. The spotting in of just a few ties at various locations on a bridge should offer no problems. Of course on some bridges, it may be advantageous to panel the deck ties. This, of course, would require the CWR to be cut out. Unless there is a special condition, it would be more economical to panel those bridges with conventional jointed rail.

Stringer replacement in Timber trestles

Replacement of stringers in timber trestles would be done in the same manner as you would with bridges with conventional bolted rail, changing out one side at a time while keeping the other side anchored to the caps and the line bolts or spikes intact. In fact, most all of the repairs or replacements of timber trestles can be accomplished in the conventional manner, as long as caution is used and the track alignment is maintained.

Ballast deck bridges: Repairs to waterproofing

Repairs to waterproofing of either steel or concrete ballast deck bridges should again be done in short segments of 15 to 20 feet. As the ballast is removed, adequate blocking must be provided under the ties to support the live load and sufficient lateral blocking provided between the ends of the ties and the ballast retainers to maintain track alignment. Thus provided, the process of making the repairs can then be accomplished.

Top flange repairs to steel bridges

Most top flange deterioration occurs on girders having angle flanges and repairs are often made by placing a one-half inch cover plate on top of the flanges and welding it in place. This again is done in short segments, jacking the deck up just the minimum to allow the placement of the cover plates on both girders at the same time to maintain cross level and tack welding the plates, letting the deck down and completing the welding, shifting the ties as necessary to accomplish a continuous weld. Track alignment must be maintained, and as most of the work area is on the outside of the girder it would be necessary to remove the deck bolts to apply the cover plates. It would be prudent to place sufficient bolts on the inside of the girder as necessary to keep the alignment should the rail temperature rise above that at which it was laid. Should the ties not be dapped, additional line bolts should be used.

Replacement of bridges

When it becomes necessary to replace a bridge that has CWR on it, depending on various circumstances, it would be more expedient to cut out that portion of CWR affecting the bridge, making sure sufficient anchors are applied to the rail off each end of the bridge opening and temporarily replacing it with bolted rail until the bridge is replaced. Then the CWR could be reinstalled and field welded at the cut joints.

Precautions during work

Daily inspection by field forces of the work area should be made to assure themselves that the approach rails are adequately anchored. The deck ties should be fully bolted to allow maximum speed of trains. Expansion devices, if any, should be maintained so that they are properly working. When necessary for the safe operation of train movement, slow orders should be placed restricting train speed. If it is possible, these slow orders should be only effective during the work day, with the deck bolted properly at the close of each shift to allow normal speed during non-working hours. At the completion of any work project, all deck fastening anchors should be securely snubbed up, all rail anchors on or off the bridge should be properly adjusted and the approach dumps should be tamped up to the proper elevation. Before leaving the job site the B&B Supervisor should assure himself that all current standards regarding the use of CWR on bridges have been adhered to.

A vast amount of knowledge must be obtained concerning bridge work with CWR. Our engineering forces are continuously working on improved methods of handling CWR and the maintenance of the various structures over which it is laid, striving for safety, stability and economy.

Mr. King: Thank you, Mr. Haines, for an interesting and informative discussion. I am sure this is a problem we all have encountered and your report has created some interest for discussion.

This concludes the report. Mr. Haines, you are excused with the Thanks of our Association for your effort. I now return the rostrum to Mr. Iwinski.

Mr. Iwinski: The Sponsor for the Special Report on "Effect of Unit Train Operation on Bridges" is Mr. J. G. Robertson. Will he please come forward to present the Chairman.

Mr. Robertson: Chairman of this report is Mr. F. D. Day, Systems Engineer Structures Maintenance, ConRail. He was assisted in the preparation of this report by the Committee Members.

Mr. Day will now present the report.

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Effect of Unit Train Operation on Bridges

SPECIAL SUBJECT COMMITTEE NO. 3

COMMITTEE—F. D. DAY, *Chairman*, system engineer structures-maintenance, ConRail, Philadelphia, Pa.; E. F. GRECCO, *Vice-Chairman*, supervisor engineering, B&LE, Greenville, Pa.; B. J. ANDREWS, B&B supervisor, C&NW, Green Bay, Wis.; J. A. ERSKINE, structural engineer, ICG, Mobile, Ala.; L. D. GREEN, associate structural engineer, SL/SF, Springfield, Mo.; B. J. KING, bridge engineer—C. L., AT&SF, Los Angeles, Ca.; G. C. PAYNE, division engineer—River Division, SL/SF, Chaffee, Mo.; J. D. RILEY, assistant B&B Supervisor, C&NW, West Chicago, Il.; M. P. OVIATT, process engineer, Southern, Atlanta, Ga.; C. E. THOMPSON, assistant B&B Master, CPR, Nelson, Can.

This report will consider the effect of the so called "Unit Train" on bridges.

A unit train can mean different things to different people. At a recent meeting of the AREA Scale Committee, now Committee 34, several definitions of a unit train were given ranging from a minimum train of 10 cars from a single shipper to a definition requiring 200 cars from a single shipper. Interspersed were discussions of whether a unit train could consist of, say, four sets of twenty-five cars each to be considered a unit train within an overall unit train of 100 cars. A lot of controversy as to what precisely is a unit train exists.

For our purpose here, however, let us consider a unit train to be a block of 100 cars, 100 tons net each, originating with one shipper, carrying one commodity, utilizing all the same size cars and destined to the same consignee, usually coal. While this is a pretty rigid classification, you will see later why some of the conditions have a greater effect on bridges than do others.

This typical unit train can carry, nowadays, almost any bulk commodity ranging from wheat, thru coal, iron or aluminum ore, phosphate for fertilizer, wood chips, sand and gravel. By far the majority of heavy trains are for transporting coal and with our present day focus on energy, it is obvious that coal handling will grow.

The train consist, insofar as tonnage is concerned, ranges from a 7000 ton minimum train to 12,000 tons maximum for one set of engines. Some of the railroads are adding radio controlled slave units at the third point of the train permitting them to handle up to 20,000 tons or 200 cars.

Where and how far do we see the trains operating? From short 10 mile mine to power plant runs to as great as the new 1800 mile runs on the Montana, Wyoming to Indiana routes. Many of the originating mines are now on new branches built just for the particular traffic, such as the Black Mesa route. Others utilize existing branches, but, really, all the heavy routes, at some part of the travel, encounter some portion of our main lines.

A survey made in connection with this report brought out that today nearly 300 unit trains per day are operating and are generating better than 700 million gross tons per year. Speeds are averaging 40 miles per hour.

The wear and tear on the roadbed and bridges has been accelerating until it has now reached the point where the heaviest 315 thousand pound four axle cars are being outlawed by some railroads on many branches and even on main lines. The cost to keep up the track and the bridges is becoming economically unsound. Much heavier rail, larger tie plates, stronger ballast and shorter cycle maintenance are all features that have been implemented on the eastern coal handling roads where much daily heavy traffic is handled.

Bridge conditions, of course, are our

immediate consideration here. We have many kinds of bridges handling unit trains; steel, timber, concrete. Some of the roads hauling the heaviest commodity, iron ore, are blessed with no timber bridges at all. These roads have been in the heavy load business for a long time with the result that they had to provide heavier original design standards. Most of the roads now taking ten thousand ton unit trains designed their bridges for steam locomotives weighing about 170 tons but the important point, was that you only had one steam locomotive or perhaps two to a train. They handled cars that were an average of 70 tons per car. The heavy Eastern coal users were power plants. Many did use great quantities of coal in these 70 ton hoppers but now all the new cars are being built for 100 ton loads. This, on the face of it, is almost a fifty percent increase in axle loads from 70 tons per car to 100 tons per car. To add to the problem, most of the steel bridges were built about 70 years ago and most of the timber trestles have been maintained for more than 40 years. Concrete bridges from the 1910 era still hold up well. Their mass and ballasted floor construction reduce the direct pounding that open floor steel and open floor wood trestles take from repeating heavy axle loads.

We conducted a survey to get some opinions on the effect heavy unit trains are having on the bridges. Of 28 roads solicited we got back 21 answers, which was a remarkable good return. Here is a part of the statistics developed from the survey.

Have unit trains increased in the last 15 years?
18 Yes 1 No

Have you had any bridge distress from unit trains?
13 Yes 4 No

Has there been any steel problem?
7 Yes 8 No

Have you had timber trestle problems?
11 Yes 2 No

Has there been any trouble with concrete bridges?
1 Yes 15 No

Do you need more frequent inspection of bridges?
7 Yes 5 No

For timber bridges, do you encounter split caps?
9 Yes 4 No

Do you have piles or bents rocking?
10 Yes 3 No

How about ties crushing?
7 Yes 6 No

Do you have posts or piles punching caps?
7 Yes 7 No

Have you had to add extra longitudinal bracing?
9 Yes 6 No

From these answers it is pretty obvious that we have all been getting into trouble with timber trestles. Some are having trouble with steel bridges but not many are having trouble with concrete bridges.

Now what particular incidents have occurred with some of the trestles and why?

A very interesting story was submitted by one of our committee members. Part of his story is included concerning an incident on a large Midwestern road:

"Prior to the operation of unit trains on the railroad with which I was associated, it was the usual practice to omit rail anchors on open deck trestles. This had come about because of problems experienced when anchorage similar to that used on the grade (6 to 8 ties, box anchored per 39 foot rail length) was continued across open deck bridges. The forces exerted on the anchored ties were greater than the tie fastenings could restrain and damage to ties, hardware and guard timbers resulted. On the other hand, if the anchorage was omitted, it was observed that although there might be back and forth movement of the rail with respect to the deck amounting to several inches, no adverse effects resulted. Additional anchorage was, however, usually placed on the track immediately off each end of an unanchored bridge so as to limit the rail movement to the section on the bridge proper.

In 1966 our Company prepared for the initial movement of an aluminum ore unit train from Mobile to St. Louis. The train consisted of forty 263,000# gross weight capacity cars with 36″ diameter wheels, 2 axle trucks, 5′-10″ axle spacing on trucks and 37′-6¾″ truck center spacing. At that time there was considerable concern with rock and roll action, particularly at low speeds at which harmonic motion was likely to develop for cars of this type operating on jointed tracks. Instructions were, therefore, issued to maintain uniform speed of 35 miles per hour, which had been found to be satisfactory for these cars. On the first run, a number of supervisory personnel accompanied the train. Nevertheless, several cars near the rear end of the train **derailed** just after crossing a 44 panel open deck pile trestle approximately 536 feet long. This bridge was preceded by a 46 foot earth embankment firebreak and that by another open deck bridge about 850 feet in length. The aggregate length of the two bridges and the firebreak was approximately 1430 feet throughout which the track was not anchored. On the embankments at each end of this section the track was securely anchored with each tie box anchored for a length of about 500 feet. The track structure consisted of 90# rails, 23 ties per 39 foot rail lengths, slag ballast, well maintained.

Examination following the derailment did not reveal any defects of track or equipment which would account for the accident, but it was noted that on the bridges south of the point of derailment, the rails had moved longitudinally from 8 to 12 inches, whereas on the embankment north of the derailment the movement was only about 2 inches.

The next time the unit train operated over this territory, a five mile per hour slow order was imposed and an observer stationed where the former derailment had occurred. This time, as the second from the last ore car was leaving the bridge, both rails **on the embankment** adjacent to the end of the bridge suddenly kinked laterally. Fortunately, due to the slow speed, derailment did not occur.

The above incidents indicated that under unit train operation on open deck bridges, the longitudinal movement of the rails can produce very high compressive forces. This was further demonstrated by another occurrence the following year. A bridge was destroyed by fire and was replaced by a 39 panel (40 bent) open deck pile trestle. Bents No. 1 thru 4 and 36 thru 40 on the end slopes varied from 4 to 24 feet in height. The other bents were quite uniformly 24 feet high. The bridge was on tangent and the rail was 112#. Here again, the rail on the bridge was **not anchored** on the **bridge,** but was quite solidly anchored on the approach embankments. Traffic, which included north bound loaded coal trains of about 100 cars each was allowed to resume at slow speed before all of the longitudinal bracing had been installed on the bridge. Shortly thereafter, the men working on the bridge reported that excessive longitudinal movement of the stringers was taking place under trains and had threatened to roll the caps off the low stiff bents at the ends of the bridge. Subsequent measurements showed that under individual unit trains, the rails moved as much as 5 inches with respect to the stringers, while the stringers moved some 2½ inches with respect to the ground. In each instance, the rails moved in the same direction as the train while the stringers moved in the opposite direction.

Without attempting a detailed analysis of the foregoing effects, it can be visualized that as a load moves across flexible beams such as in a timber trestle, the deflection of each span produces a lengthening of the base of the rails at the same time as the tops of the stringers on which the rails are supported are compressed and shortened. This results in a differential motion, or creeping action of the rail with respect to the stringers in the direction in which the train is moving. When a large number of loaded cars moved in succession across the trestle there is a cumulative build up of this motion, which is also probably further intensified when the truck spacing of the cars approximates a multiple of the panel length of the spans.

If, as in the first example mentioned above, the structure is relatively rigid, and the rail off the ends of the bridge also unyielding, dangerously high compressive stresses in the rails at the leaving end of the bridge result. Conversely, as in the last example, if the structure is flexible, it will be forced in the opposite direction. Presumably, at the same time as compressive stresses develop in the rails at the leaving end of the bridge, tensile stresses develop in the rails at the opposite end of the bridge, but within my experience, the tensile stresses have not presented the most serious problems.

In the case of trains of mixed consist, which include cars of varying lengths, as well as light cars, the above effects are not ordinarily severe enough to cause difficulty. Apparently, the cumulative sequence is less pronounced and there is a release of stress during the passage of the lighter cars.

The solution which we applied to this problem consisted of securely anchoring the rail on open deck trestles more than about 400 feet in lengths where unit trains operate. This was done by box anchoring every second tie and securing these ties to the stringers with two ¾ inch diameter drift pins per tie. In addition, all ties are fastened to the 4″ x 8″ guard timbers with ¾″ diameter x 9″ lag screws. Examination of some of these bridges several months after the above anchorage had been installed showed that it was effective in reducing the movement of the rails to about ½ inch relative to the bridge structure and that the timber and hardware involved was not being damaged materially by excessive forces.

At another location on an Eastern line, a 100 car train at 30 MPH passed over a 150 ft. trestle. As the caboose was clearing the bridge, the 12 bent posted trestle went down like a set of dominos standing on end. The caboose just made it but the track was hanging partly in air.

At still another location on a trestle using freight car side beams for stringers, men working on the trestle noticed excessive movement of the car beams at the caps with beams flexing and trying to push off the top of the caps. Again, what was causing all this dangerous movement?

When other trains with mixed freight crossed any of the above trestles, no serious movement in the trestles occurred.

What solutions are possible? One has already been mentioned; anchoring across the bridge.

Another remedy was to add longitudinal bracing where any was missing. Where water areas prevented extra cross bracing, additional 12″ x 12″ timbers were blocked between the caps at the outside ends of the caps.

The best solution seems to be to block between all ties and box anchor every tie on the trestle as well as 600 feet ahead and behind the trestle. This solution solidly holds the rail and prevents the compression built up in the rail from being released as a kink in the track. Continuous train action gradually distributes the rail stress and eventually equalizes the anchorage. Of course, all ties are pinned to the stringers and all stringers and caps are pinned to one another.

The dangerous possibilities to those of you who are just getting unit trains cannot be over emphasized. Much additional inspection and probably more bracing or other remedies will have to be applied to the trestles. Our concept of anchoring rail to bridges will have to be reconsidered.

On the whole, the unit trains are here to stay. Our M of W people have joined in resisting any further increase in wheel and axle loads on rail. We will have to live with what we have but, with the experience so far, the railroads will have to change bridge design to heavier, more solid, construction for future unit train loads.

Mr. Robertson: Accept the thanks of our Association for a fine report involving a problem we have and will become more aware of. I feel sure there is some discussion and questions to ask.

This concludes the report. Mr. Day, you are dismissed with our thanks for an interesting and informative report. I now return the rostrum to President Rankin.

Effect of unit train Operation on bridges

President Rankin: Fred Day effectively discussed and illustrated the problems that we so often encounter from unit train operations. He also talked of derailment, raging rivers and similar spectacular occurrences. Now we will examine the destruction of the timber trestles which mercilessly go on every year. These do not rate headlines nor news bulletins, but, nevertheless, cost the railroad much greater sums of money. To supplement some of our reports, or bring before us specialists on various matters of interest, we have made a practice of obtaining those outside the industry to give us special features. Mr. Stan Noyszewski is the Chairman of our Special Features this year. I now call on him to introduce the first of our Special Features.

Mr. Noyszewski: Our next speaker obtained his Bachelor of Arts degree from Baylor University, his Master of Science from the University of Washington and the Doctor of Philosophy from Yale University.

His extensive experience includes over 20 years of service as a wood products pathologist with the U.S. Forest Products Laboratory in Madison, Wisconsin. For the past 2½ years he has been in private consulting practice and his clients have included Dallas, Baltimore, Canadian railroads, the State of Alaska, U.S. Forest Service, U.S. Park Service and many others.

We are very pleased to present to you Dr. Joe Clark who will discuss "Wood Decay in Bridges."

Dr. Clark:

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Wood Decay in Bridges

By JOE CLARK

Wood Pathologist, U.S. Forest Service, Retired

Introduction

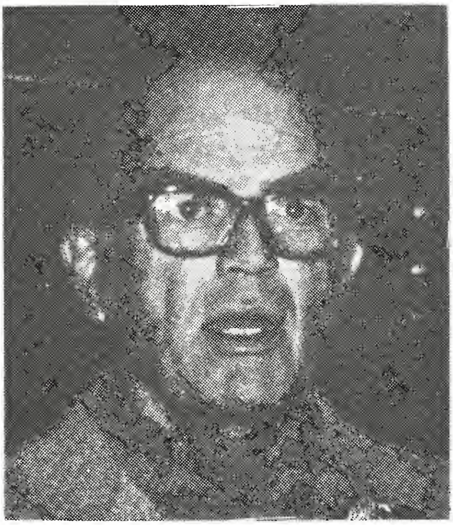
Early decay development in most bridges is hidden. Decay develops in all wood not properly treated. It develops in native timber materials, in untreated air-seasoned materials and in reused salvaged materials.

Many times decay starts within a year after the bridge is built. When it begins depends on the materials used in the bridge, the design of the bridge, and the exposure of the bridge to weather and other conditions. Some bridges do not start deteriorating for some time, depending on the above factors.

During regular inspection of bridges, a search for decay must be made. An estimated ninety per cent of all wooden bridges are lost to decay eventually. Many think fires, overloading, or floods are the worst enemies, but decay causes the big loss to the railroad industry in the wooden bridge department.

If regular inspections are made, bridges are well-built of treated materials, and are well-maintained, they can last for forty, sixty, or more years. However, decay can seriously damage a poorly designed and untreated bridge in as little as six or eight years.

Some of the factors affecting decay probability in bridge members are design, durability of the wood, inclusion of sapwood, preservative treatments, age, position and exposure of members and climate. In design particular attention must be paid to wettability of critical areas. Some woods have better durability because of innate decay resistance. Annual precipitation has much to do with the life-span of the bridge, especially, if the design has not taken wettability into consideration.



Joe Clark

Considering the variability in bridges as to design, age, climate and exposure, it is best to understand the decay process. Also it is well to inspect individual bridges on the basis of their individual characteristics.

Wood decay

Wood decay is caused by living fungi which are simple plants which can not make their own food. They require sufficient oxygen, favorable temperatures, an available supply of free water, and an adequate, favorable food supply.

Heart rots inside living trees illustrates minimum oxygen need. The decay rate is limited in wood submerged in aerated water. But, always, there has to be some oxygen for decay to grow.

The fungi grow in temperatures from 40 degrees to 95 degrees F. Cold temperatures do not kill the fungi but high temperatures may. Change of seasons, naturally occurring temperatures, seldom limit fungi decay. Southern latitudes, lower elevations and southern exposures contribute to longer yearly periods of growth of the fungi. Dark wood surfaces are not penetrated deeply by heat even if they reach high temperatures in the sun.

The available supply of free water must be over thirty per cent for fungi growth. Moderate to high rainfall is the chief source of water in above-ground bridge parts. Since water is essential as a solvent for the fungi enzyme system, and can be sufficient although only localized in the wood, the decay hazard is generally correlated with yearly rainfall.

The sub-structure of the bridge may also become wet by soil moisture or stream water. Even condensation may be a hazard. A bridge design which has a water trapping structure, even in areas of low rainfall, may contribute to wood decay.

When wood grains are exposed, decay can start. End-grain surfaces are easily wettable when exposed as sawn, bored, or notched surfaces. Flat or edge-grain faces are resistant to moisture absorption unless subject to water for prolonged periods of time.

The moisture content of bridge members can be controlled to some degree by design, by preservative treatment and by surface coatings.

Different fungi may use different parts of wood as food. Little strength loss results if the fungi are of the mold or staining variety. Wood cell walls used by decay fungi may cause severe strength loss. It only takes a small weight loss in wood from decay to cause significant strength loss. Many kinds of decay fungi do not cause decay in bridges. The fungi which cause the significant strength loss in bridges eat tunnels which are sometimes mistaken for termites. A termite rarely attacks bridge timbers. In some cases carpenter ants do, but most of the strength loss can be attributed to the decay fungi.

Brown rot and white rot arise as a consequence of the parts of cell walls used as food by decay fungi. Brown-rot fungi use cellulose preferentially and leave a residue of lignin. White-rot fungi use both cellulose and lignin and leave a residue of both materials. Which materials are left depends on the enzyme system of the specific fungi involved. Both born and white rots usually occur as interior decay. Soft-rot fungi, only recently recognized, are commonly found as surface decay in very wet areas. These fungi are generally slow acting and significant only in very old bridge members.

How does decay start?

The fungi spores are like seeds of higher plants. They are present everywhere and are distributed by wind, water, insects and birds. Another way of getting the fungi into the bridge structure is to use an already infected wood which spreads to the good wood. If you bridge-builders recognize the requirements of the fungi to grow, and their characteristics, you can stop much trouble in your inspections for the decay. You will also know the requirements for their growth and will prevent all the favorable food conditions you can.

No complete resistance To wood decay

All naturally decay resistant woods as well as preservative-induced resistance in treated woods are limited in stopping fungi growth.

Nature has built a decay resistance into many woods. This resistance is natural due to extractives in the heartwood. Sapwood does not have this resistance. The distribution of extractives is heavier in the outer heartwood. The toxicity of extractives varies between and within wood species. Water solubility of extractives is also variable between species as are fungi tolerances of these extractives. Most native construction timbers are no better than moderately resistant, and, therefore, all are benefited by preservative treatment.

In preservatives, creosote or pentachlorophenol in heavy oil are most widely used. Another preservative used is FCAP (fluor chrome arsenate phenol).

Many methods are used in applying preservatives:

1. Seasoned versus non-seasoned wood
2. Pressure methods versus non-pressure treating
3. Penetrations
4. Retentions
5. Incising
6. Pre-cutting and boring

All of these methods have been tried and all are used but there are no pre-treating or post-treating methods which are complete preventatives to decay. They help and are necessary to prevent wood decay but all are far from perfect. Different woods react in different ways to different methods of being treated. But, no wood nor method yet known can completely prevent the decay fungi from eventually getting started. However, careful inspections, pre-treatment of naturally resistant woods, post-treatments, and the use of good bridge design will see wooden bridges which will last for half a century or more.

Much interested discussion followed this report.

President Rankin: Thank you, Mr. Clark for your fine report. From the discussion you can tell of its interest to our organization.

This concludes our program for today. We will re-convene in Joint Session with the Roadmasters, at 9:00 A.M. tomorrow morning, in Regency Rooms B, C and D.

I declare the First Session adjourned. (Gavel)

MORNING SESSION

September 27, 1977

A Joint Session of the Roadmasters and Bridge & Building Associations was called to order Tuesday Morning, September 27, 1977, at 9:05 o'clock, Mr. W. H. Rankin, President of the Bridge & Building Association, presiding.

President Rankin: Will the second Joint Session of the convention please come to order.

Our registration to this point is, Roadmasters, 260 — Bridge & Building Association, 115 — Associate members, 147 —Guests, 100 — Total of 632. This compares with a comparable figure of 623 at this time last year. We have 112 of our ladies registered to this point.

On behalf of the Roadmasters and B & B Associations, I would like to extend to all a sincere welcome.

I will present to you some of the members of our Executive Committee whose duties required that they be elsewhere yesterday. Will the gentlemen please stand as their names are called and remain standing until all are introduced. Please withhold your applause until all have been introduced.

Starting at my extreme left:

Mr. W. C. Sturm, our 2nd Vice President, Senior Project Engineer, E. J. & E. Railroad, Joliet.

Mr. D. C. Gould, our 3rd Vice President, Assistant Structural Engineer, Union Pacific, Omaha.

Mr. W. H. Huffman, our Treasurer, Retired, Assistant Vice President and Chief Engineer, C. & N.W.

Mr. J. Budzileni, a Director, Assistant to Bridge Engineer, Chicago, Rock Island & Pacific, Chicago.

Mr. B. J. King, a Director, Bridge Engineer, Coast Lines, Santa Fe Railroad, Los Angeles.

Mr. J. G. Robertson, Director, Manager, Engineering Design, Bessemer & Lake Erie, Greenville, Pennsylvania.

We will skip the next three gentlemen, who will be introduced to you at a later time on our program.

Mr. J. R. Williams, our Immediate Past President, Engineer of Bridges, Chicago, Rock Island & Pacific.

Mr. J. R. Iwinski, our 1st Vice President, who is Assistant Chief Engineer of Public Works, Chicago & North Western at Chicago.

The next gentleman will be introduced at a later time on our program. You may now applaud this fine group of people. (Applause)

I will now turn the rostrum over to President Cruse.

President Cruse: Gentlemen, I, too, welcome you with Mr. Rankin to this second Joint Session.

At this time, I would like to introduce some of the Officers and Directors of the Roadmasters and Maintenance of Way Association. There are a number of others who could not be here at this time because of their duties attending to the affairs of the Convention.

I will start at my extreme right and, as I call their names, please stand. Please withhold your applause until they have all been introduced.

Director H. M. Hamilton, Engineer, Track & Roadway, Canadian National Railways, Capreol, Canada.

Director, H. P. Harris, Roadmaster, Seaboard Coast Line, Hamlet, North Carolina.

Director, R. V. Hernandez, Roadmaster, Southern Pacific Transportation Company, Bloomington, California.

Director, M. B. Mitchell, Assistant Division Engineer, Southern Railway, Somerset, Kentucky.

Director, B. D. Sorrels, Division Engineer, Atchison, Topeka & Santa Fe, Amarillo, Texas.

Director, D. J. Gale, Engineer of Track, Union Pacific, Salt Lake City, Utah.

Director, Dr. W. W. Hay, Professor of Railway Civil Engineering, University of Illinois, Urbana, Illinois.

Director, M. S. McClendon, General Roadmaster Systems, St. Louis, San Francisco, Vinita, Oklahoma.

2nd. Vice President is out at the desk.

1st. Vice President, R. K. Pullem, Division Manager, Engineering, Chessie system, Akron, Ohio.

Our next speaker will be introduced at a later time.

You may now applaud. (Applause)

I now turn the rostrum over to President Rankin.

President Rankin: It is now my pleasure to introduce our next speaker, who will bring us a keynote address. He is a most knowledgeable person on maintenance of way matters. He is held in highest regard by the Engineering and Maintenance of Way Department of the Frisco Railroad.

He is a native of Cuba, Missouri.

Included in his education is attendance at the Transportation program of American University, and the Executive Program in Business Administration at Columbia University.

All of his experience in the railroad industry has been with the St. Louis-San Francisco Railway Company. He started as a brakeman in 1941 and advanced through various positions in the Operating and Sales Department.

In January of 1969 he was elected to the position of President, and was designated to be the Chief Executive Officer in November of the same year. He was elected to the additional position of Chairman of the Board in December of 1973.

In addition to his duties with the Frisco and its subsidiary companies, he serves as a Director of twelve industries or associations. Those related to the railway industry include the Illinois Terminal Railroads Association, St. Louis, the Association of American Railroads, the Western Railroad Association, the Association of South Eastern Railroads, and the Transportation Association of America.

He also serves on the Board of Trustees of Drury College, Springfield, Missouri.

In the face of such demanding business affiliations, he also has taken time to be active in civic affairs by serving on the Executive Board of the Boy Scouts of America, United Way of Greater St. Louis.

It is with the greatest of pleasure that I present to you Mr. R. C. Grayson, who will address us on "A Positive Look Ahead." Mr. Grayson. (Applause)

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A Positive Look Ahead

By R. C. GRAYSON

Chairman of the Board and President, St. Louis-San Francisco, St. Louis, Mo.

Good morning, ladies and gentlemen.

Thank you very much, Warren, for those nice things that you had to say about me. It's pretty easy to get nice things said about you from a guy who works for you.

Some one told me when I came in here this morning he liked to come up here because he would always see a lot of Frisco people if he would look on the program and find out when I was going to make a speech. I hope that not all the crowd, or not even half, are Frisco people, Warren, and that some came for other reasons.

I wish to thank you for inviting me here to this, your 82nd Annual Convention. I think the age of your group, not those here, but the age of your Association, certainly ranks as one of the first, if not the first, of these types of Associations in our industry.

I would also like to take a moment to congratulate you on finishing your term as President of the Bridge & Building group. I'm sure it has been a good experience for you and I know that you have served your Association well.

R. C. Grayson

There are many things, I suppose, that one could talk about in the railroad industry today. It's easy to find a subject. Our industry, I suppose, claims to be beset with more problems than almost any others. I don't think that is necessarily true. Certainly I wouldn't have time to talk about all the things that I think are very important. One thing I am not going to try to tell you fellows is how to build a bridge or how to fix track. You're all experts in that field. And certainly my old friend Cot McClendon, sitting over here, would be the first to correct me and tell me to sit down, that I didn't know what I was talking about. And Warren would tell me the same about bridges.

One thing you can always be sure of, though, when you come to these meetings is that the Roadmasters and Bridge people are always up and around and going early. You know, some of the groups you go to address, such as a sales convention, it is pretty hard to get anybody up at that time in the morning.

I expect all you guys have gone around and inspected the building and called home to see if everything is on the track and no bridges fell down last night. You are always up early and going the first thing in the morning. That's the creed of the bridge builders and the track men. A group of the most loyal employees we have in our industry. I never miss an opportunity to say to all of you wherever gathered that you are a group that I am always especially proud of in our Company and in our industry. You are always there when we need you and there is never a gripe about how tough the conditions are or how hard the job. The idea is to go out there and get it done.

Back to trying to find something to talk about this morning. As I said, it is easy to find a lot of subjects, but I chose just a couple that I want to talk to you just a few minutes about, they being the problems of regulation, or rather, I suppose, the problems of over-regulation in our industry. Maybe we should call it strangulation in these days. It seems to be a little better word because it seems we do not have the regulations that were intended and as we once knew it. We have regulations piled on top of regulations, bureaucratic orders on top of bureaucratic orders, to where it seems that the most time consuming part of our job is to make reports to some federal or state agency.

The other thing I want to touch on a little bit here is another of my favorite subjects and one that has an impact on all of us in our business. That is the competitive inequities that exist in the transportation industry today. They are fostered and thrust upon us by the federal government, so I think that it is necessary that we exert all the influence we have to try to get some competitive balance and equity in our business.

A positive look ahead

There is an old saying that "Those who cannot remember the past are condemned to repeat it."

As railroads move toward the 21st century, we ought to plot our course so that we can avoid the pitfalls which impeded our progress in years gone by. Our rapport with the public and its elected representatives will be crucial in the years ahead. We need the support of the public's elected representatives to obtain a more even-handed treatment of the various modes of transport and relief from over-regulation.

Regulation of our industry began in the 19th century when rail carriers had a clear monopoly and a highly unfavorable public image. As a result, our freedom to manage has been greatly circumscribed by an ever-widening web of restrictions ostensibly to protect the public interest . . . . even though today the transportation industry is highly competitive.

Railroads helped nation to grow

At this point in time it seems ironic that we should have ever been regarded as an adversary of the public . . . because no other industry did more to build and settle this country. It was the Iron Horse which opened the West . . . even before there were enough people to patronize its services. People settled this continent before it was explored. Towns were laid out before there were a sufficient number of people to make them viable communities. Among the many promotional efforts of the day, rail carriers even sent agents into foreign countries to encourage migration to the new frontiers.

The way midwestern and western railroads were built was in sharp contrast to the way rail lines were laid down in England. As one English visitor to America said back in the 1800's, "In England we build our railroads from one town to another. In America they build them from nowhere in particular to nowhere at all."

In the race to build a transcontinental railroad through a wilderness, little attention was paid to the economics of railway location. Had such practical considerations not been ignored, we would not have the surplus trackage and routes which burden our industry today.

Surplus tracking a major problem

Surplus trackage is today one of our major problems. It is one that we could easily solve ourselves were it not for its political ramifications. It should be a source of satisfaction, however, to realize that this industry has the technical skills and the managerial know-how to solve all of its present problems . . . were it not so hobbled by regulation and so pressured by subsidized competition.

The inability to abandon non-profitable trackage has worked a particular hardship upon those rail companies which might have remained profitable if only they had had the freedom to retire the burdensome non-profitable lines they were forced to operate. On the Frisco alone, we calculate that fully ten per cent of today's rail mileage is a burden and ought to be abandoned. The money it costs could be more productively applied to the upkeep and improvement of the still profitable part of the rail plant. Counting the cost of rail, track material, ties, surfacing and labor, it takes an expenditure of anywhere between $100,000 and $130,000 to upgrade a mile of railroad to 132 lb. standards. Programs to upgrade our bridges and displace our wooden trestles likewise are requiring heavy outlays of cash.

At present cost levels, and given our current earning power, this industry no longer can afford to allocate money to lines which can no longer be economically justified and which are only being utilized on a now and again basis.

New regulations delay abandonment

In our attempt to gain approval of abandonment applications, we are now contending with new regulations which further delay proceedings. In passing the 4R Act, Congress did two things: first it recognized the need for quick action in stemming the financial drain on rail carriers which operate non-profitable lines. And second, it voted in favor of subsidizing continued rail service to any individual or government entity which needed it and was willing to pay a sufficient amount to help offset the losses incurred by the carrier.

Unfortunately, the inclusion of a provision to subsidize non-profitable operations has resulted in a further delay in abandonment proceedings. Current regulations now require us to file a system diagram map upon which we must show any line of railroad which we believe may be the subject of a future abandonment application. These maps must be sent to the ICC in Washington as well as to the governor and to the designated agency of each state through which the railroad operates.

Any non-profitable line upon which an abandonment application will be filed must appear on the system diagram map, as such, for a period of four months before an application is filed with the ICC. So far, roughly 16,000 miles of line have been identified as "potentially subject to abandonment."

But the most detrimental effect of the current regulations is caused by the rules regarding economic information on a track subject to abandonment. The current rules require — and presumably the ICC will make its determination upon — the present physical condition of the line to be abandoned. The current rules require a statement of rehabilitation costs to bring the line up to Federal Railroad Administration Class I safety standards. This necessarily infers that the line has deteriorated to scrap. Because a railroad will often defer maintenance on a non-profitable line, the rehabilitation expenses are normally a major factor in proving it is not profitable. Under current rules, the railroad is being forced to either (1) include rehabilitation costs to bring the line up to Class I standards, thus admitting that it has been operating a line which does not meet the minimum safety standards of the FRA, or (2) exclude rehabilitation costs altogether, thus weakening its ability to prove non-profitability.

We feel that these regulations as presently written circumvent the intent of Congress as expressed in the Quad R Act and make it virtually impossible to abandon a single mile of track. We have therefore appealed to the courts. Hopefully we will be successful in getting these regulations changed so that we can go forward with our retirement programs.

Transportation market should be competitive

In passing the Quad R Act in 1976 the Congress, among other things, accepted the necessity of creating and maintaining an open and competitive market in transportation in which all modes compete on equal terms and market shares are governed by customer preference based upon service and full economic costs. Congress directed the Secretary of Transportation to examine ways and means by which this goal might be achieved.

The Secretary of Transportation in the Ford administration, Mr. Coleman, concluded among other things that federal subsidies to inland water transportation have been unsound economic policy and unfair to transport modes competing with water carriers, principally railroads. Said the Secretary . . . and I am quoting "The maintenance of an open and competitive market among mature modal competitors requires the elimination of most, if not all, federal subsidies to transportation. Where circumstances require long term federal financial involvement in the operations of a mode of transportation, such federal involvement should be based upon the appropriate form of cost-sharing or cost recovery." End of quote.

Unfair subsidies to waterways

In recent months the House of Representatives' water resources subcommittee of the Committee on Public Works and Transportation has held hearings on the assessment of waterway user charges. Testimony already presented before that body indicates that during the decade 1965 through 1975 the Corps of Engineers alone has spent nearly $3.6 billion in operating, maintaining and constructing our system of inland waterways. This figure does not include money spent on the Great Lakes and on coastal harbors. The commercial waterway carriers, who are the direct beneficiaries of these federal expenditures have paid no licensing fees, user charges or any other fee for the use of these publicly financed rights of way. According to the Congressional Budget Office, these policies and programs have the net effect of providing 41 cents of taxpayer money to match every dollar paid by those who ship by waterway.

Our industry feels that waterway subsidies are both inequitable and unsound economic policy. The rail industry and rail shippers cannot but be seriously disadvantaged by a policy which provides such large public subsidies to the commercial water industry.

During the same eleven years that the federal government spent $3.6 billion on waterways, the railroad industry had to spend about $19.7 billion of their own revenues for construction and maintenance of their own roadway. In addition, they paid nearly $2 billion more in taxes on roadway and track property. So while waterway shippers were receiving a government subsidy for right of way of about 41 cents for every dollar they paid to ship by water, railroads had to spend about twenty cents of each revenue dollar to maintain their right of way.

The failure to enact user charges for the use of facilities built, operated and maintained by the government gives barge operators a "free ride." Furthermore, the total absence of any investment responsibility on the part of commercial waterway users leads to decisions to make major public investments in the waterway system which are not subject to any meaningful commercial tests such as those which govern investments in other parts of our national freight carrying system. If we had a full cost recovery system of waterway user charges, it would help assure a rational solution to this controversial investment problem.

User charge equitable

If a user charge were to take the form of a uniform toll per ton-mile on shallow draft vessels — and using figures from the 1977 Corps of Engineers' budget for inland projects — the appropriate user charge to recover 100% of the

Corps' expenditures for operation, maintenance, rehabilitation and construction would be 3.01 mills per ton mile. While this figure may seem high in relation to the level of barge rates charged shippers, which average 6 mills per ton mile, it is only a reflection of the very high level of Corps' expenditures on waterways as indicated in the finding of the Congressional Budget Office.

If instead of the uniform ton-mile toll, the user charge is to take the form of a fuel tax, the tax necessary to recover 100 per cent of 1977 expenditures for operation, maintenance, rehabilitation and construction of inland waterways would be approximately 64¢ per gallon. Again, this amount seems high in relation to the price that waterway operators must pay for fuel. In fact, it would more than double the price of that fuel, currently about 35¢ to 40¢ per gallon. To put this figure into perspective, however, one must realize that if the federal government paid for railroad roadway maintenance, construction and taxes in 1976 — the equivalent of its involvement in the inland waterway system — and recouped those costs from a tax on the fuel railroads consumed, the fuel tax would have been 86¢ per gallon.

Whatever choice is made — fuel tax or tolls — railroads take the position that the level of user charges should be tied to inland navigation expenditures, rather than fixing them permanently at some amount per ton-mile or per gallon of fuel. It is not unlikely that future expenditures will rise faster than fuel consumption and user charges should keep pace. This will serve to impose a useful discipline on waterway users and the Corps of Engineers, forcing them to weigh costs and benefits against each other.

Subsidies and regulations should be eliminated

Each year our government spends billions of dollars on transportation facilities and subsidies. Only about half of one per cent of that involves railroads, and most of this small amount goes to Amtrak or to other forms of passenger service. The more than 99% remaining goes to benefit transportation modes which compete with railroads.

For years we have had the luxury of a resilient national financial structure which provided us with a wide margin of error to cushion the impact of unsound transportation decisions. But the cumulative impact of many unsound decisions over the decades — combined with the limitations on our country's financial resources — has reduced the margin of error to a thin line between viability and insolvency. We are at the point now where one or more bad decisions favoring one form of transport over another may bring more railroads to their knees.

It was the uneven hand of federal support to competing modes of transport which played a key role in the collapse of the rail system in the northeast and midwest. Having materially assisted in creating the competitive and financial pressures leading to such collapse by its policies, the government was then forced by political and economic necessity to rescue the bankrupt carriers through grants and loans. Thus aid begets more aid . . . subsidy begets more subsidy. Because the government subsidizes Amtrak, bus operators now are also seeking aid.

The elimination of subsidy and excessive regulation in the transportation industry would serve to restore the working of the free market, with everyone competing on equal terms. Then, and only then, will market shares be governed by customer preference based upon service and full economic cost.

President Rankin: Thank you, Mr. Grayson, for taking time to share with us from your expertise in the industry.

We invite you to stay with us for as much of our program as you care to. However, we realize you have a busy schedule, so, please feel free to leave whenever you wish.

At this time, I return the rostrum to President Cruse.

President Cruse: It is now my pleasure to introduce our next speaker, Mr. Robert F. Lawson.

He was graduated from Ohio State University with a degree in Civil Engineering in 1940.

He also received an Advance Management degree from Harvard University in 1967.

Mr. Lawson started with the New York Central Railroad in Springfield, Ohio, in 1940, in the Engineering Department and held jobs as Assistant Division Engineer, Division Engineer, Methods Engineer, District Engineer, Assistant to the General Manager, Engineer, Maintenance of Way System, and General Manager at New York.

After the merger of the New York Central and the Pennsylvania Railroad, he was appointed General Manager of the Eastern Region at Philadelphia and General Manager of Passenger Operations Assistant.

He came to Amtrak on January 1, 1975, as Chief Engineering Officer and on August 1, 1975, was appointed Assistant Vice President and Chief Engineer. Mr. Robert F. Lawson. (Applause)

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AMTRAK and Its Relationship to Maintenance Of Way Activities in the Northeast Corridor

By R. F. LAWSON

Chief Engineer, AMTRAK, Washington, D.C.

R. F. Lawson

Thank you, Bill.
Members of the Convention
Ladies and Gentlemen:

I want to thank you for inviting me to talk to you at this convention today.

It is my purpose to try to explain to you what is Amtrak and its purpose as well as how I, as Chief Engineer for Amtrak, handle the maintenance of way functions on our system. I will also dwell somewhat on our Northeast Corridor Improvement Project and what is involved.

Our current name is National Railroad Passenger Corporation, but we are known as Amtrak. This means American trains and track.

A little history:

In 1929, the nation's railroads, operating some 20,000 passenger trains, carried 77 per cent of intercity passenger traffic by public mode in the United States. Buses carried 15.4 per cent and the airlines, an immeasurably small amount.

By 1950, more than half the passenger trains had disappeared, and the railroads' share of the intercity passenger traffic had declined to 46.3 per cent. In the meantime, traffic on buses increased to 37.7 per cent and the airlines' share had grown to 14.3 per cent.

Twenty years later, in 1970, railroad passenger traffic dropped to 7.2 per cent of the commercial share and the number of trains still operating were less than 450. Of these, about 100 were in the process of being discontinued. Airlines dominated the public carrier market with 73 per cent, while buses, still in second place, held on to barely 16 per cent.

By this time, it was increasingly recognized that the country's excessive reliance during the past four decades on the private automobile and the airplane for intercity travel had left the nation with a serious imbalance in its transportation network.

The formation of Amtrak was proposed as it became more evident that the United States could not rely solely upon further massive construction of highways and airports to meet its transportation needs. It was argued that the strangulation of our central cities and such environmental problems as air and noise pollution, excessive land use and dislocation of people, make unrestricted expansion of these facilities impractical and hazardous.

Creation of a national rail passenger system was viewed as a method to save an alternate form of transportation that possessed a priceless asset — existing tracks and rights-of-way — into the major population centers of the nation. These rail facilities could be upgraded quite economically when compared to the costs for construction of new highways and airports.

The country's growing population and increasing mobility was also offered as evidence that an efficient rail passenger service was needed, especially in high-density corridors. Over 20 per cent of U.S. households do not own an automobile. Millions of people do not drive and many of the 24 million people with incomes below the poverty level cannot afford to drive. Further, fear of travelling by air is a phobia that touches the lives of an estimated 25 million Americans. Adequate public transportation was deemed essential to insure mobility for these and other groups and, it was stressed, rail passenger service must be retained if balance were to exist in the transportation system.

Little was said, during the debate to create Amtrak, about the vital role railroad passenger service would play during a future energy crisis. It was not until the fuel shortage of 1974 that railroad passenger transportation was seen as, potentially, the most energy efficient form of people movement.

Amtrak created

Amtrak was created when the Rail Passenger Service Act was enacted on October 30, 1970. A Board of Incorporators was found to organize the corporation.

On Amtrak's first day of operation, May 1, 1971, it inherited a dying business. Not one railroad operated a computerized reservations system. The majority of the rail passenger cars were old, and many were in disrepair. Too many of the stations and maintenance facilities had been neglected and were inefficient and unsightly.

On its first day, Amtrak did not own any railroad tracks, any stations, any terminals, any yards or repair facilities, any locomotives, any passenger cars or other railroad equipment. Not one manufacturer in the U.S. was building intercity rail passenger equipment.

For the first two years, Amtrak was almost totally dependent on the railroads, leasing equipment from them and using their facilities. An Amtrak customer could make a reservation, buy a ticket and complete his journey without ever coming into contact with an Amtrak employee. The Congress had given Amtrak only a two-year experimental period of life, with no fixed route structure beyond that time, and planning future improvements was excruciatingly difficult.

The underlying thrust of Amtrak's first efforts was to revitalize, gradually, public confidence in rail passenger service through service improvements, and, thereby, attract the travelling public back to the trains. Amtrak viewed its first few years as a building period.

The Corporation began with some specific goals: To increase the consideration with which railroad employees served the public; to offer reliable performance and well-maintained equipment, and to issue accurate information to travelers.

Most of all, Amtrak developed positive programs to entice an increasing share of the travel market to train travel. The principal target: the 87 per cent of intercity travelers who use private automobiles.

Amtrak was incorporated by eight Presidential appointees who were faced with enormous tasks when they began work on January 1, 1971, four months before the Corporation would be responsible for the nation's passenger service.

They had to begin organizing what is comparable to a $200 million public service corporation; to decide what specific routes should connect the 21 "pairs" of cities designated by the Secretary of Transportation as the national system; and decide what trains, frequencies and type of service to be operated effective May 1.

Up until this time, the Corporation had been commonly referred to as "Railpax." A leading design firm was retained to develop a new name, and Railpax became "Amtrak."

Beginning May 1, 1971, Amtrak assumed the responsibility of managing the operation of 23,000 route-miles of intercity passenger trains between the 21 city-pairs designated by the Secretary of Transportation.

The 13 railroads that signed contracts with Amtrak and immediately began operating Amtrak service were: The Santa Fe; Burlington Northern; Baltimore & Ohio-Chesapeake & Ohio (now Chessie System); Milwaukee Road; Louisville & Nashville and Seaboard Coast Line (now The Family Lines). Also included were: Missouri Pacific; Penn Central (now part of ConRail); Richmond, Fredericksburg & Potomac; Southern Pacific; Union Pacific; Gulf, Mobile & Ohio and Illinois Central (now the Illinois Central Gulf).

Because of route expansions, Amtrak later signed contracts with the Boston & Maine; Central of Vermont; Canadian National; Grand Trunk Western; Norfolk & Western; and Delaware & Hudson.

The Rail Passenger Service Act, enacted on October 30, 1970, created Amtrak to manage the basic national passenger network and be responsible for the operation of all intercity passenger trains under contracts with the railroads.

The legislation identifies three underlying purposes and objectives of the Corporation: (1) Provide modern, efficient intercity rail passenger service within the basic rail system of the nation; (2) Employ innovative operating and marketing concepts to develop fully the potential of modern rail service in meeting intercity transportation needs; and (3) Strive for operation on a "for profit" basis.

Amtrak Improvement Act

This fundamental philosophy has remained, but the Act has been amended in several respects since. The Amtrak Improvement Act of 1973 continued Amtrak's authority beyond the original two-year experimental stage and locked into law for a minimum of one year all of the routes which Amtrak was operating at the end of 1973. The new Act also stated that quality of service should be a major factor in determining compensation to the railroads for the services they provide.

The Amtrak Improvement Act of 1974 expanded Amtrak's scope of responsibilities. It required the Corporation to directly perform its own maintenance and repairs, and directed

Amtrak, the U.S. Railway Association and the Secretary of Transportation to cooperate in a project to improve service in the Northeast Corridor.

The Amtrak Improvement Act of 1975 authorized, for the first time, financing for Amtrak for more than a one-year period, and authorized cash grants for capital improvements rather than federally guaranteed loans. The Act also directed Amtrak, the Secretary of Transportation and the Interstate Commerce Commission to submit to Congress proposals setting forth criteria and procedures under which Amtrak would be authorized to add or discontinue routes.

The Amtrak Improvement Act of 1976 mandated that the President of Amtrak shall automatically become an ex-officio member of the Board of Directors. This Act also amended the Railroad Revitalization and Regulatory Reform Act to permit Amtrak to purchase the Northeast Corridor railroad line.

How financed

The Corporation is financed by a combination of earned revenues from passenger service operations and Federal Government assistance. The one exception is a $197 million "entry fee" paid by the railroads over a three year period as compensation for Amtrak assumption of rail passenger service. The fee was equivalent to one-half of the participating railroads' passenger service operating losses for 1969. These funds were used by Amtrak to cover operating expenses.

Government assistance has been provided in terms of cash appropriations to cover operating expenses and a mixture of guaranteed loan authority and direct grants for capital improvements.

Federal support of Amtrak reflects a decision by government that public policy requires continuation of essential rail passenger service at public expense, although at cost levels lower than have been provided to other transport modes. It should be noted that no major railroad passenger system in the world earns a profit, although individual routes within a few systems do.

Amtrak control

Amtrak is subject to varying degrees of oversight, review, regulation, auditing, and certain forms of administrative control by a multiplicity of government agencies, as follows:

Comptroller General; Office of Management and Budget; Department of Transportation, including Office of the Secretary; Federal Railroad Administration; National Transportation Safety Board; Interstate Commerce Commission; State Departments of Transportation; Governors' offices; Mayors of 512 Amtrak cities; Metropolitan Transit Authorities; Department of Treasury; and Department of Commerce.

Amtrak legislation and appropriations for government assistance are handled mainly by four committees of the Congress, which also exercise oversight responsibility.

The Rail Passenger Service Act, as amended, states that the Board of Directors shall consist of 17 members, as follows:

8	Appointed by the President of the United States
2	Ex-officio members
3	Representing Common Stockholders
4	Representing Preferred Stockholders (vacant)

The President of the United States nominates and the Senate confirms eight members of the Board, of whom not more than five shall be from the same political party. Of these eight, not less than three shall be designated consumer representatives; further, not more than two consumer representatives shall be from the same political party.

The two ex-officio Board members are the Secretary of Transportation and the President of Amtrak.

Three Board members are elected annually by the common stockholders of the Corporation. Shareholders were created by a provision of the Act that permitted railroads to take stock instead of tax write-offs — Burlington Northern, Milwaukee Road, Grand Trunk Western, and Trustees of the former Penn Central.

Four Board members are to be elected by preferred shareholders. To date, no preferred shares have been issued and these seats remain vacant.

Because Amtrak is a large and widespread corporation, it is organized into 13 departments, each charged with specific objectives:

Executive
Computer Systems
Executive Planning
Finance
Government Affairs
National Operations
Marketing
Northeast Corridor Operations
Operations Support
Public Affairs
Legal
Personnel and Administration
Labor Relations

Amtrak accomplishments

Amtrak has had many notable accomplishments during its first six years.

By 1977, more than three out of every four passengers on short-distance trains and about half of all passengers were riding in new equipment purchased by Amtrak within the last 3½ years. The standard of service being provided today is a far cry from May 1, 1971, when Amtrak began service with an equipment fleet inherited from the railroads.

Amtrak started operations with 286 diesel and 40 electric locomotives, and 1,275 cars, all purchased or leased from the railroads. As riders increased, Amtrak bought more equipment as needed. The last major addition to the fleet of old cars was precipitated by the energy crisis in the winter and spring of 1973-74 when Amtrak found 112 usable cars after an extensive nationwide search. Slightly over $114 million was spent in the first three years to purchase and repair this equipment.

The majority of these cars were over 20 years old, and the railroads had not been ordering intercity equipment and manufacturers had stopped building it. After two decades of service most cars badly needed renovation and mechanical overhaul, and Amtrak began to perform such work in November, 1971.

The advanced age of the fleet made the need for new equipment quite obvious. Amtrak developed a capital program to purchase turbine trains for short-distance routes, Amfleet cars for corridor and medium-distance routes and newly designed bi-level cars for long-distance routes.

Amtrak began operating French Turboliners beginning in the summer of 1973 from Chicago to St. Louis, and later to Detroit and Milwaukee. In each instance the attractive new equipment brought passenger gains. Amtrak began service with two of the French trains, but ultimately purchased four more. Amtrak also ordered seven Americanized versions of the Turboliners and placed them in service on the New York-Albany-Buffalo line in the fall of 1976, and on the Adirondack route to Montreal in the spring, 1977, once again sparking increases in patronage.

Beginning in October, 1973, Amtrak placed a series of orders, totalling 492 Amfleet cars, at a total cost of $206.3 million. The cars have an improved suspension system, public address system, attractive and carpeted interiors and seating that may be increased or decreased depending on the market served. The first Amfleet train operated in test revenue service on August 7, 1975, from Washington, D.C. to Boston. Amfleet equipment now operates on a dozen routes throughout the nation. Like the Turboliners, Amfleet has caused sizable passenger increases.

New equipment

For long-distance service between Chicago and the West Coast, Amtrak has placed on order 284 bi-level cars at a cost of $206.2 million. The first of several orders was placed in April, 1975. The first cars will enter service by the fall of 1977, illustrating the long lead times involved in equipment purchases.

This bi-level equipment, named the Superliners, will be unmatched anywhere else in the world. The new cars, with their stairways, double-levels and generous lounge and dining areas, will provide a train more spacious and varied than ever before. Improved air-cushioned suspension systems will give a smoother ride, and sound-absorbing materials will isolate the passengers from exterior noise and mute sounds within the train. Standardization of components will make the cars considerably easier to maintain than Amtrak's present aged fleet of long-distance cars.

In an effort to further improve the sophistication and reliability of its passenger equipment, Amtrak has extensively tested electric locomotives leased from Sweden and France. The Corporation also has leased two high-speed Canadian-built LRC (Light, Rapid, Comfortable) trains for test operations between Vancouver, Seattle and Portland.

Amtrak has spent or committed $582.7 million in capital funds over six years to buy a variety of new equipment, as follows:

150 diesel 3,000 hp. locomotives (SDP40F).
26 electric 6,000 hp. locomotives (E60CP).
492 Amfleet cars.
25 diesel 3,000 hp. locomotives (P30 CH).
40 lightweight 3,000 hp. diesel locomotives (F40PH).
13 five-car Turboliners (including two under lease and already in service).
235 bi-level Superliner cars.
49 Superliner cars.

Maintenance and repair services

Amtrak has assumed many servicing, repair and maintenance functions formerly performed by the railroads. The Corporation now owns and operates various types of maintenance and servicing facilities, located in Beech Grove (Indianapolis), Boston, Buffalo, Chicago, Dallas, Detroit, Harrisburg, Houston, Jacksonville, Kansas City, Long Island City, Los Angeles, New Haven, New York, Newark, Philadelphia, Rensselaer (Albany), Savannah, St. Louis and Wilmington, Delaware.

Amtrak has built one new maintenance base, Brighton Park, in Chicago, for repair and servicing the Midwest Turboliners, and has under construction a $14.8 million Turboliner maintenance facility north of the Albany-Rensselaer, New York, station. Under construction in Rensselaer, is a 113,000 square-foot building with two turbo service tracks, a diesel repair track, an all-weather car washer, auxiliary shops, storeroom, employee facilities and offices. When complete in late, 1977, the shop will handle diesel locomotive work as well as that for the Turboliners, and will employ an estimated 125 persons.

Improvements are underway to several facilities purchased from the railroads. On February 24, 1977, Amtrak announced the start of a $6.8 million program to begin modernizing the 12th Street maintenance yard and 16th Street locomotive shop in Chicago. It is the first phase of a $38 million modernization program scheduled for completion by 1981.

On April 1, 1975, Amtrak purchased from Penn Central the rail car overhaul and repair shops at Beech Grove, Indiana, for $3.8 million. It is Amtrak's primary heavy overhaul and car modernization facility and it, too, is undergoing renovation.

Northeast Corridor acquired

With the acquisition of the Northeast Corridor from the Consolidated Rail Corporation (ConRail) on April 1, 1976, Amtrak became a full-fledged operating railroad. The property acquired comprised 456 route-miles from Boston to Washington, 62 miles from New Haven to Springfield, Massachusetts, and 103 miles from Philadelphia to Harrisburg, for a total of 621 route-miles.

The properties, along with selected equipment, were conveyed to Amtrak from bankrupt railroads through Con Rail under terms of the Regional Rail Reorganization Act of 1973, as amended by the Railroad Revitalization and Regulatory Reform Act of 1975.

Operating on Northeast Corridor lines is an average of 960 trains a day, including over 120 Amtrak trains, nearly 660 commuter trains under contract with transportation authorities, and more than 170 ConRail freight trains.

In addition to trackage, Amtrak purchased 107 railroad stations and numerous maintenance shops and yards at key points along the route. The purchase price for Northeast Corridor facilities was about $86 million, the net liquidation value certified by the United States Railway Association. The purchase agreement between Amtrak and ConRail calls for payment over an eight-year period, with an option for accelerated payment.

The Boston-Washington route will undergo improvements in a program enacted into law on February 5, 1976. The $1.6 billion program calls for upgrading of the Corridor within five years. An additional $150 million in federal money, to be matched by state funds, has been authorized for improvements to non-operational aspects of stations and the installation of right-of-way fences.

On April 1, 1976, when we acquired the Northeast Corridor, we also acquired approximately 1,630 employees in the Maintenance Department. These consisted of track, bridge and building, signal, communication, and electric traction employees. Today we are employing approximately 5,000 employees in these categories. Most, of course, are in the track work area.

We have been working with the Federal Railroad Administration on the Improvement Master Plan for the entire corridor. Please keep in mind that the Northeast Corridor Improvement Project only covers the spine from Washington to Boston and not the lines from Philadelphia to Harrisburg or New Haven to Springfield, although it is a part of the Northeast Corridor.

The project is broken down into basically 11 areas as follows:

1. Track.
2. Bridges.
3. Realignments.
4. Signals/Track Coded.
5. Electrification.
6. Communications.
7. Grade Crossings.
8. Stations.
9. Service Facilities.
10. Tunnels.
11. Fencing.

The project requires us to operate trains in the corridor to provide a schedule of New York to Washington in 2 hours and 40 minutes and between New York and Boston in 3 hours and 40 minutes. This must be effective by February 1, 1981. Of course, in this territory we do have work seasons; therefore, we must plan to have the track in shape to make this schedule by November, 1980. It does mean that we must have train speed of 120 mph to make such schedules.

In the track area we will use concrete ties on approximately 400 miles of track. These will be installed using track relaying machinery along with undercutter cleaners and the most modern tamping and lining machinery.

We still have considerable trackage to be upgraded by conventional methods in the corridor.

We also expect to own and operate a track geometry car in this corridor.

In the bridge program we expect to replace 34 bridges and rehabilitate and repair 343 bridges. A number of proposed ballast deck bridges were eliminated due to the cost.

The curve realignments were originally figured as a major project but due to limited funds, this has now been reduced in nature to more or less minor curve adjustments. You must keep in mind this is electrified territory and any changes in alignment not only affect the track but also the wire.

Signals/track coded will require new signal systems north of New Haven to Boston as well as a portion of centralized traffic control south of Wilmington, Delaware, also, a new signal system Harold to Shell. We will modernize the remainder of the system.

Electrification requires a change in the present 11 KV 25 Hz system to a 25 KV 60 Hz system. Also, a complete new system will be required from New Haven, Connecticut, to Boston, Massachusetts, as no electrification now exists in this territory. The MTA/CTA territory is in the process of changing the present 11 KV 25 Hz system to a 12.5 KV 60 Hz system from Shell, New York, to New Haven, Connecticut. This system will probably exist for several years; therefore, in carrying out this project, our equipment must be able to convert and operate on three different systems such as 11 KV 25 Hz, 12.5 KV 60 Hz and 25 KV 60 Hz. You can begin to see what a few of our problems are in carrying out such a project.

The communications consist of a new and modernized trunk line, telephone and radio.

Grade crossings consist of elimination of 19 private road crossings and 49 public road crossings.

Stations will consist of operational improvements in 11 stations.

Service facilities consist of six equipment repair shops and 14 maintenance of way bases.

Tunnels consist of rehabilitation of the tubes in New York as well as the tunnels at Baltimore.

Fencing, which is to be mostly matched money by the states involved and is somewhat complicated, probably will involve areas of safety in the initial stage.

Most of the work to date has been done by railroad forces except some bridge jobs which have been left to contract.

To date, we have completed some of the work as follows in the corridor:

Rail	32 miles
Ties and surface	143 miles
High speed-surfacing	164 miles
Undercutter cleaner	21 miles
Shoulder cleaning	71 track miles
Joint elimination	2,500 joints

We are also starting the reconstruction of a 110′ span bridge over the Woonasquatucket River in Providence and the clean-up of the right-of-way in a 94 mile area. We are starting to paint the catenary poles and bridges.

Efforts being made to improve

I have spent considerable time travelling in the United States, Europe and the Far East to gain all of the technology I can to use in this program. We do not want to reinvent the wheel, but take advantage of others' mistakes. I know we will make some mistakes but we do intend to do the job and on time.

I hope I have given you some insight on Amtrak and our problems. Thank you.

President Rankin: As we are running a little ahead of our schedule, we do have a little time that you might direct some questions to Mr. Lawson. Many of us are not involved with Amtrak and know little about it. So at this time I would open the floor to any questions that anyone might have for Mr. Lawson to enlighten us.

Member: With all this expenditure of money, how much of a market have we gained with Amtrak? It was 7%. What is it now?

Mr. Lawson: Are you referring to the increase in number of passengers?

Member: Yes, sir.

Mr. Lawson: It has been coming up, particularly in the Corridor of between 7% and 10%. One of the problems we have had this year, which, if I remember the number, is somewhere around 6%, due to the fact with all the work that we have to accomplish in this corridor, we are advising the public of a downgrade in passengership in the Corridor simply because there is no way we can do all this work and run these trains on time.

Most of the people, of course, who ride the Metroliners are pretty well wed to the Metroliners. It is a good service. Unfortunately, in the last several months we have been running about 15 minutes late. With the AmFleet, which is a slower train, more people are beginning to pick up the AmFleet, which is a little lower fare, but it doesn't have the prestige that the Metroliner does.

We really expect, as the time goes on and as we try to accomplish this work, our riders will probably drop off and then really take off.

Member: What about your long distance trains?

Mr. Lawson: In the long distance trains, only a handful are involved in this project and that's the ones that start out in New York and go to Florida and start out of New York and come to Chicago. The ones that start out of New York to Chicago have to come only to Philadelphia and then they divert and head towards Harrisburg, which is still our line, and run over ConRail. The Florida trains, of course, must fight the battle all the way to Washington before they head south to Florida.

Member: Are they increasing in rides?

Mr. Lawson: Yes, they are.

Member: Are there any plans for doing major work on the New Haven in the Springfield and Philadelphia area?

Mr. Lawson: There are plans to do work on those routes that fall into our normal, let's say Amtrak maintenance, plans. As it stands today, and as I told you fellows earlier, we are still a private corporation. We do get our money from Congress. We are subsidized by the Congress, but we do have to work up a budget and justify our budget just like any other railroad. And on that basis we do plan work on each of those lines.

After maybe another couple of years, there is still a possibility that both of those branch lines will eventually be turned into part of this NECIP project. But as of today, it is not part of the NECIP project. Does that answer your question? Any other questions?

Member: What kind of voltage power will you use with all those various voltages?

Mr. Lawson: Well, right today we are in the process of taking bids on modernization and rehabilitation of the Metroliners. And they are capable of being converted. The GG-I's, when we switch from the 11 KV. 25 Hz. power, are done. They are not convertible. We are looking at some new SAL locomotives. The new equipment that we are buying today will be convertible, as a matter of fact, to the three different powers. The E60's that we bought are convertible. They are already wired. It takes a little more work on them but they will be compatible to make the transfer. The ConRail freight locomotives have a problem. Again it will depend upon phasing and how it is worked out with the rest of the equipment.

Any other questions? I am surprised no one has asked me about — and I'll volunteer this one — about the track relaying machinery. I guess one of the reasons that I finally became interested in the track relaying machinery, after looking at it all, and going out and talking to Chief Engineers all over the world, is what type of quality of work do you need if you are going to really run high speed? And, hopefully, how to hold down some of your maintenance costs? I personally have the feeling that, with the method we use to construct our tracks, the conventional method, and the tolerances that we permit, and the suppliers who furnish us with material, we can not build our railroads and live within the tolerances that are already condemnable in Europe and Japan.

By using the track relaying machinery, which, by the way, can be used with either wood or concrete ties, you are forced to preplate your ties and get away from the business out here in the field of handing the people a lot of spike malls and machinery and setting the rail down to a quarter inch wide or a quarter inch tight or a half inch. I have looked at a lot of rail on our own railroad that was a half inch wide, which was relatively new rail, and had to be laid that way, and I'll guarantee you that you cannot afford to run those kinds of speeds and axle loads we run in this country with those kinds of tolerances.

Most of the European railroads deal in 2 to 3 millimeters. This was one of bauer who gave an informative slide presentation on "Criteria for Selection of Metal vs. Masonry Outbuildings."

President Rankin: Mr. Milbauer please accept the Thanks of our Association for an interesting and informative presentation.

I now call on Mr. Noyszewski to come forward to introduce the participants of our second Special Feature.

Our next presentation is a symposium on "Fire Retardation for Bridge Decks."

Participants are representatives of Koppers Company and Osmose.

Mr. W. R. Hyma, Bridge Engineer-System, of the Santa Fe will introduce the gentlemen and act as moderator.

Mr. Hyma.

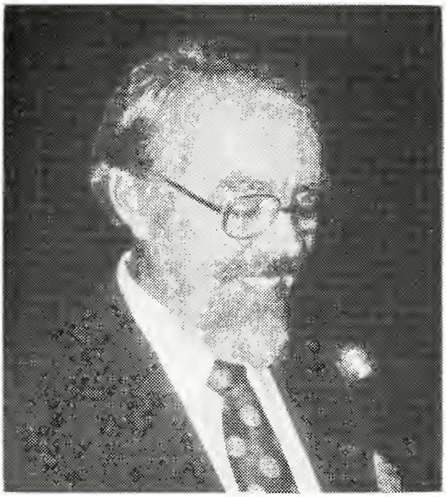
SYMPOSIUM ON FIRE RETARDATION FOR BRIDGE DECKS

W. R. Hyma, W. T. Henry, Henry Mader, J. B. Ledingham, Kenneth J. Norton

Introduction

By W. R. HYMA

Bridge Engineer System, Santa Fe, Chicago



W. R. Hyma

Two years ago, Tom Fuller presented a special feature to this group on the replacement of a 1,000 ft. trestle on the Southern Pacific destroyed by fire. Last year, Alf Dahlberg presented a similar feature on the restoration of a 1,400 ft. trestle on the Santa Fe. Thus, it's appropriate that this year we devote some time to ways of preventing these fires or at least minimizing the losses.

With thousands of miles of timber bridges and bridge decks, and annual fire losses measured in the millions of dollars, this matter of fireproofing is one of serious concern, especially on the day after a fire when we look into our crystal ball and try to guess where the next one will be.

Fireproofing divides itself Into two categories

Fireproofing rather naturally divides itself into two broad categories; one, the in-place coating of existing timbers and the other, the impregnation of new timber with fire retardant additives during the treating process. The most widely used coating is manufactured by Ocean Coatings, Ltd. and distributed by the Osmose Co. and we have with us today Brian Ledingham, President of Ocean Coatings from Vancouver, British Columbia and Ken Norton, Sales Manager of the RR Division of the Osmose Co., Madison, Wisconsin. The leading producer of fire-retardant treated timber is the Koppers Co. Representing their Forest Products Division, we have Bill Henry, Resident Manager of Operations, Product Development Department, from Orrville, Ohio and Hank Mader, Product Manager, Fire Retardant Treated Products, from Pittsburgh, Pa.

We will have a question and answer period at the end of the presentations and, to insure adequate time for all our participants, I will ask you to hold your questions until then.

To get started I would like to call on Bill Henry.

Pressure Impregnation of Fire Retardant Materials

By W. T. HENRY

Resident Manager of Operations, Product Development Department, Orrville, Ohio

What are fire retardants?

In discussing fire retardants, one would ask, "What are fire retardants as related to wood?" The answer is "Fire retardants are chemicals which prevent the spread of flame or the penetration of fire in wood once the source of ignition is exhausted."

Fire retardant chemicals are applied to wood by one of two methods. They can be applied superficially as coatings, and you'll hear more about this from the Osmose people, or they can be applied by means of pressure impregnation. It is this latter method to which I'll confine my remarks. I'll take you on a tour of a treating plant; give you some thoughts on development and testing; and cover quality control procedures in commercial plants.

A typical treating plant has stacks and stacks of forest products such as crossties and utility poles. In a fire retardant treating plant, you might also expect to see cedar shakes and shingles, plywood, decorative panelling, scaffold planking and the like.

Material to be processed in a fire retardant treating plant is carefully loaded on metal trams which are rolled on rails into a pressure autoclave, or treating cylinder. Once the material is in the cylinder, the door is closed and bolted tight. A vacuum is then applied to the cylinder and its contents to remove air from the wood cells. While the vacuum is maintained, the cylinder is flooded with treating solution until it is completely filled. The concentration of the fire retardant solution is adjusted for the commodity being processed but usually runs between 10 and 20 percent. After the cylinder is filled with solution, hydraulic pressure is applied (up to 150 psi) and maintained until the wood in the cylinder will accept no more. The solution is then returned to the storage tank and the treated material is removed from the cylinder.

Since the fire retardant solutions are aqueous, it is necessary to dry the treated material following its removal from the cylinder. This is accomplished by transferring the treated material to kiln trams and kiln drying the treated material. This operation required from 5 to 14 days, depending on the commodity being dried.

Basically, there are two general categories of fire retardants. One group is called interior and the other is an exterior (NCX) type. The interior formulation must be protected from the leaching action of rain and the elements. The exterior type, may be used in interior applications or in applications completely exposed to the weather. In fact, the exterior formulation was developed initially to treat shakes and shingles, thereby serving a need in the southwest where shakes and shingles are frequently used for their decorative appearance on costly homes in that area. Treatment provides protection of roofs which are occasionally exposed to flying embers from brush fires.

Tests used to evaluate retardants

When a new or reformulated fire retardant is in the development stage, there are many tests to which treated wood is exposed. Some of these are ASTM standard tests, some are not.

One test which we have used occasionally is a roof corner test—developed some years ago at the U.S. Forest Products Laboratory in Madison, Wisconsin. For this test, a section of a roof—a corner—is erected using fire retardant treated material. A pan of fuel oil is set on the floor of the roof corner and ignited. Flames from the fuel oil shoot 15-20 feet into the air for 7-10 minutes until the supply of fuel oil is exhausted, at which time the fire goes out and the roof deck, except for slight charring on the underside remains intact. The same test performed on a roof corner constructed of untreated wood results in an inferno which collapses after several minutes into a pile of burning rubble.

A second evaluation test is one developed by Koppers and Factory Mutual. In this test, a box 6 x 4 x 6 ft. is fitted with 'chicken wire' and several hundred slats each 3/8 x 1-1/2 in. x 6 ft. are placed in the wire in a configuration very similar to that of the fill of a cooling tower. A pan of fuel oil setting under the fill is ignited and burns vigorously for several minutes. Using untreated fill material, a conflagration develops in minutes and envelopes the entire interior in flames. Within a few minutes the fill crashes to the floor of the box in ruins. When NCX treated fill is tested, after the fuel oil is exhausted, three or four slats that are in direct contact with the flame of the burning fuel oil drop down while the remainder are intact.

The above tests are two of many employed in evaluating fire retardant treated material.

I'd like to cover one other test of a different nature. Whenever any candidate preservative or fire retardant is under study, we impregnate 10-20 stakes each 3/4 x 3/4 x 18 in. with the formulation. These stakes are then driven into the ground such that 10 in. is embedded in the ground and 8 in. remains out of the ground. The stakes are installed in a wooded area near Charleston, South Carolina. Once a year, each stake is inspected and rated for the presence or absence of insect attack or decay. The NCX treated stakes, while they do not give the protection that would be expected of creosote, have given service several times that which has been established for untreated stakes.

Next step rating tests

After a fire retardant formulation has 'passed' the 'in house' tests and we feel it is worthy of commercial application, we go to the Underwriters and Factory Mutual Laboratories.

At Underwriters, fire retardant treated material is evaluated in the fire hazard classification test chamber (ASTM E84). In this test, the material being tested forms the roof of a 25-ft. long horizontal tunnel. Ignited fuel (methane or natural gas) is introduced at one end at a rate of 5000 BTU per minute. A draft of 240 ft. per minute is introduced at the same end. Using untreated oak, the flame races over its surface in a matter of less than 10 minutes, thus a flame spread rating of 100 is established. When cement asbestos board is tested, there is no spread of flame. Thus its rating is 0. With fire retardant treated lumber we aim for a Class A rating which is a flame spread of 25 or less when compared with these two standards. Instruments connected to the apparatus control the flow of fuel and the draft and measure temperature, smoke generated, etc.

At the Factory Mutual Laboratories, a full scale room test is conducted on the treated product. In this test two walls forming the corner of a room are covered with the material to be tested. The wall covering material extends from the floor upwards 30 ft. to the ceiling. Several oak pallets are then piled on the floor in the corner (700 lbs. of fuel) and are ignited. Flame from the burning pallets extend up to the ceiling. The pallets burn for 30 to 40 minutes. During this period, observations are made of the spread of flame along the ceiling edge of each wall. With combustible material, flames would move across that portion of the wall in seconds. With fire retardant treated wall cover, there was no spread of flame whatever and after the fuel was exhausted the only portion of the wall covering that was damaged was that part in direct contact with flames from the burning pallets.

The room corner test, as discussed above, is a full scale test. It is costly to prepare and test. Thus, Factory Mutual developed a smaller scale test, which to a certain extent, is a combination of the ASTM E84 tunnel test and the room corner test. In this test, the roof and sides of a tunnel are formed using only the material to be tested. The bottom is left open. An ignition flame is introduced at one end and observations are made as to its rate and amount of spread along the three surfaces. Untreated wood practically explodes into flames. Fire retardant treated material is only charred and this only at the point of contact with the ignition fuel.

Quality control tests After rating given

After fire retardant treated material has been assigned a rating which is acceptable to insurance rating bureaus and/or building code requirements, the product is now ready to be produced commercially. To insure that the treated product complies with standards developed at the time of testing, three separate quality control tests are conducted. These tests are:

1. Solution analysis
2. Determination of penetration
3. Small scale fire tests

1. A sample of the treating solution is taken from the treating cylinder in which the commodity is being processed. This sample is returned to the laboratory of the inspection agency where it is analyzed for chemical components to make certain that the composition and concentration agree with that of the solution used in treating the original test specimens.

2. When the treated material is removed from the processing cylinder, small samples (cores) are taken from a representative number of pieces in the charge. By means of chemicals stains, the depth to which the fire retardant has penetrated is determined. Minimum values for depth of penetration were established for each species and commodity at the time of initial testing.

3. Finally, several fire tube specimens (3/8 x 3/4 x 48 in.) are included in each charge of material which is fire retardant treated. Following treatment of the charge, the fire tube specimens are dried and tested in the fire tube apparatus (ASTM E69). Weight loss when exposed to the flame of a Bunsen burner for four minutes is determined. Again, the values obtained must comply with values established at the time of the initial testing.

All of the results of the above tests must meet the criteria of acceptance established for each test in order for the treated material to be considered acceptable. Once this has been established, a label, indicating acceptance, is placed on each piece of material included in the charge.

This concludes my comments. Mr. Henry Mader will now discuss applications of fire retardant treated wood.

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Applications of Fire Retardant Treated Wood

By H. J. MADER

Product Manager, Fire Retardant Treated Products, Pittsburgh, Pa.

Bill Henry has just covered the developmental area of NCX fire retardant treatment (exterior) including an explanation of processing techniques and the facilities and testing equipment required to enter certain market areas.

My segment will deal with product applications resulting from this.

Koppers has entered markets for their fire retardant treated products after fires have occurred in either untreated wood or as a result of catastrophes occurring in other so-called "non-combustible" materials.

The first commercial application of our NCX fire retardant treatment formulation was for the treatment of Western red cedar shakes and shingles after the disastrous fires in Southern California over 12 years ago.

You will recall recent similar major fires occurring in Southern California this past Spring.

As a result of these occurrences, Koppers has marketed tens of thousands of squares of Underwriters Laboratories, Inc., labeled Class C and Class B roof systems for use in residential areas and also in commercial installations such as apartments, lodges, restaurants, etc., where building codes require an Underwriters Laboratories, Inc., labeled roof covering material in order to meet code requirements.

You saw in Mr. Henry's presentation testing of NCX fire retardant treated wood cooling tower components. While Koppers Company was meeting with insurance company underwriters to gain acceptance of the exterior fire retardant treatment for this use, we were shown a photograph of a fire which occurred during the construction phase of a nuclear power plant in Europe. The insurance executives suggested that Koppers had a product which they would be willing to recognize with favorable insurance recognition if we would promote its use for basic construction lumber such as scaffolding, formwork, bracing, etc., during the construction phase of nuclear power plants.

Savings gained in Use of retardant

The economics of this use are, as follows:

Should an electric utility be delayed in starting a nuclear power plant for any reason such as a construction fire, the premium they pay for electricity purchased from a neighboring utility runs in excess of $500,000 per day. Since all lumber in the construction phase of a nuclear power plant can be treated for far less than this figure, the added safety of using exterior fire retardant treated lumber has warranted its use in over 15 nuclear power plants throughout the country.

Illustrated here is the picture of the fire which occurred in Europe showing the extent of damage which occurred plus slides showing how NCX fire retardant treated lumber is used at Duke Power's nuclear power stations.

We have also utilized NCX fire retardant treated lumber for construction of temporary walkways such as that which provides access to the Cincinnati Sports Arena since permanent access stairs could not be completed in time for the opening of the stadium.

Another interesting application is the combination cosmetic/utility use in which an electric substation was enclosed by exterior fire retardant treated laminated columns, cedar shingle mansard, and board fence type enclosure so that residents in the vicinity of this substation would not be aware of what was enclosed therein. This is an interesting application since when the enclosure was completed and the substation was in operation, a fire did occur in two construction trailers which were located in the inside corner of the substation. By the time the fire department had arrived, the construction trailers had burned to the ground. Only char damage occurred on the inside facade of the enclosure. From the outside, no visible damage could be seen and burn through did not occur.

Inside fire damage was limited to the area exposed to the ignition source, and there was no further spread of fire. Cosmetic operations were performed to remove the carbon char and the facility is now restored to its original condition for minimal cost.

Since you can see how wood has performed in the test conditions described by Mr. Henry and in the above example, you may visualize yourself as to how this could apply in railroad bridge trestles where NCX treated lumber and plywood may be able to perform satisfactorily. The treatment minimizes the possibility of trestle fires particularly in critical bridges where a fire could cause a tremendous loss of revenue. Perhaps even the simple installation of fire retardant treated walkways would enable fire fighting crews to gain access to a fire somewhere in a distant section of the bridge which would be otherwise inaccessible to fire fighting crews.

Examples of use of Treatment in railroads

We can review here photographs of several fires which have occurred in various railroad trestle structures throughout the country and following this we would like to show you applications in which railroads have utilized NCX fire retardant treatment for various components in their bridges.

The Birmingham and Southern Railroad utilized NCX stringers for the purpose of preventing fire spread should a timber bent catch fire. The fire retardant treated stringers would minimize the possibility of fire spread from one bent to another.

The Long Island Railroad was concerned with fires occurring in wood passenger platforms on their railroad and hence use NCX treated lumber in the erection of new passenger platforms.

The Santa Fe Railroad utilized an interesting concept in which creosoted timber bents are completely boxed in or enclosed by fire retardant treated plywood, a move to prevent the possibility of grass fires occurring which could possibly set fire to timber bents.

The Illinois Central Gulf Railroad has used NCX treated cross ties, walkways, and hand rails to minimize the possibility of fire damage to their critical bridge at Cairo, Illinois.

The above given examples show how NCX treated lumber and plywood has been used as one engineering solution to the problem of fires in trestles and bridges.

To conclude, I would like to give two short illustrations showing case histories where fires have occurred in fire retardant treated structures.

One is at Koppers own pressure treating facility in Kansas City where an office building was erected with NCX fire retardant treated wood, the walls plastered, and in order to keep the structure warm while the plaster was drying, a salamander was placed on the plywood treated floor to maintain warmth in the structure. The salamander was overloaded with fuel and became so hot that it literally burned through the floor to the ground below. When workmen came the following morning, the salamander was resting on the ground below with its fuel exhausted and the only damage was the hole burned through the floor.

More recently, a fire occurred in a workmen's shanty in our treating plant in Orrville, Ohio. All materials in the shanty were fire retardant treated except for an architectural plywood which was used to line the inside of the shanty. In this structure, fire occurred, and, when the firemen arrived, the interior panelling had been completely gutted, the windows and doors burned through, but with only minor charring of the 2 x 4 studs and roof rafters.

The shanty has been restored to its original condition with osly the installation of new interior plywood and the replacement of doors and windows. This example may give you some ideas for applications in right-of-way shanties which are used for the storage of various equipment on your track.

We hope that the above has given you some ideas as to the various uses for exterior fire retardant treatment and how, from the above case histories, fire retardant treated wood may be expected to perform in railroad applications.

This concludes my portion of the program. Mr. Hyma will introduce the next speaker from the Osmose Company.

Coating Open-Deck Bridges for Prevention of Fire

By J. B. LEDINGHAM

Ocean Coatings, Ltd., Vancouver, B.C.

Causes of bridge fires

Bridge fires have been attributed to a variety of causes including sparks, brake slag, fusees, lightning, brush fires, tumbleweed fires and arson. With the increase in speeds and loadings of rail traffic in recent years, brake slag has emerged as a major cause, partly due to the necessity to reduce speed on some of the older bridges and trestles. When the brakes are applied, sparks generated at each brake shoe accumulate at the leading edge of the opposite shoe and form fragments which vary in weight from a fraction of an ounce to several ounces. When the slag sloughs off it is hot enough to cause ignition of bridge deck timbers.

Development criteria for a coating

One solution to this problem is to coat existing timber decks with a fire-retardant coating. Intumescent coatings are used extensively in the building industry and are very effective in protecting a flammable substrate. These coatings expand to form a carbonaceous char up to several inches thick when exposed to heat or flame. However, they have the disadvantage of losing their properties when exposed to the weather. Non-intumescent types can be weather resistant and are effective against temporary heat sources such as brake slag. The principal development criteria for such a coating could be summarized as follows:

1. High certainty of protection from brake slag—95%.
2. High probability of protection from other temporary heat sources 75%.
3. Long service life—able to provide protection for ten years or better.
4. No undesirable side effects such as acceleration of wood decay or obstruction of inspection and normal bridge maintenance.
5. Economy of material and application.

Development of neoprene coating

Between 1959 to 1967, scientists at the British Columbia Research Council on the university campus were engaged in research in inspection and control of marine-borers in timber structures. This work ultimately led to development of a coating capable of adhering to wet or dry creosoted timber, and provided the background necessary for formulation in 1967 and 1968 of a neoprene-based fire-retardant coating along the guidelines set forth above.

Description of the coating

In the uncured state, the coating is a free-flowing, heavy bodied, latex-based liquid suitable for spraying onto horizontal or vertical surfaces. As the water component evaporates, the applied coating forms a rubbery, permeable membrane which adheres to creosoted wood. The coating is formulated in such a way that moisture vapor passes readily through the dried film, permitting the coated wood to breathe and dry normally.

How the coating protects

The coating functions as an inert barrier to exclude oxygen from the substrate. A measure of thermal insulation is also provided together with chemical action to reduce flammability of hot gases.

The heat from brake slag impinging on a coated surface causes smoking and sometimes flickering, depending on the size and temperature of the slag. As heat dissipates, flickering and smoking stop and the surface cools without afterglow or flame spread. An uncoated surface exposed to the same heat source ignites immediately, producing flames that may spread rapidly or die spontaneously depending on the timber configuration and air movement. Should the flames die spontaneously, the charred surface may continue to glow or even be fanned to life again by a change in air movement of by the passing of a train.

Although the coating was developed as a bridge deck material, its properties have been examined for use on piles and caps against brush fires. For evaluation, a quarter-sized model of a trestle section was constructed and coated. Excelsior and straw burning under it for several minutes failed to ignite the timber, but did cause some blistering of the coating. A similar uncoated structure fired by the same heat source burned vigorously.

Service life

Coated pressure creosote-treated panels tested in a twin-arc wet and dry cycle weatherometer showed good retention of adhesion, minor surface erosion and moderate hardening of the coating after 3400 hours exposure. The weathered panels showed no reduction in fire-retardant properties. This established the basis for projecting approximately 10-year service life. Applications made on the former Pacific Great Eastern Railway, now the B. C. Railway, between 1969 and 1971, still have most of the coating in place, minor losses have occurred mainly around tie plates, checks and corners, and are accompanied by moderate erosion and moderate loss of flexibility. Protection against brake slag is estimated to be reduced by about three to five per cent after six to eight years in service.

Ongrowing development

Neoprene was chosen as the base of the coating for its unique combination of flexibility and fire-retardant properties, in combination with durability. To achieve its maximum potential resistance to the elements such as ozone, oxygen, ultra-violet light, heat and petroleum products, the raw neoprene is compounded with additional chemicals such as anti-oxidants, anti-ozonants ultraviolet absorbers, light-blocking pigments and curing agents. In addition, to these are added a fire-retardant, plasticizers and an anti-fungal agent, as well as emulsifiers, dispersing agents, stabilizers and an anti-settling agent. All these minor components are vital to achieving good performance. Fortunately, research in the chemical industry is very active in this field, making it possible for the coatings formulator to continually improve his product. Since original development was completed in the spring of 1968, advances were made in emulsion stability in 1969, 1970, 1974, and 1976 to improve storage life; in the plasticizer in 1971 and 1975; processing technique in 1972, 1974, and 1975; and antioxident in 1977, to improve long-term retention of flexibility. An advance in fire retardancy is currently scheduled for 1978 production and possible advances in the curing system are being investigated for additional increases in film strength.

Field application of this material is described in the following article by Mr. Ken Norton.

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Field Application of Fire Retardant Material

By KENNETH J. NORTON

Sales Manager, R R Division of Osmose Co., Madison, Wis.

One way of fireproofing timber is to introduce fire retardants into the timber in the same manner as preservatives. This, of course, is restricted to new timber — new construction.

Effective coatings, such as Nonflam®, applied to structures already in place can provide comparable protection. The two processes are not competitive. One applies to new timber, the other to existing timber structures.

Brian Ledingham has already described the various technical, scientific and research aspects of one such coating.

I would like to continue and describe how this one coating is applied, the equipment which is required, and the minor preparations necessary to achieve the desired results.

We have a short silent film to which I'll attempt to add narrative, which illustrates the application process.

Start Film

Both the timber decks of steel structures, as well as timber trestles are susceptible to fire. Someone who is familiar with the statistics might be able to list, in order of frequency, the type of fire sources responsible for bridge fires. Most, though, are a result of deck type fires started by either fusees, brake shoe slag, or white or red hot shoes themselves. These types of fire sources can be prevented from spreading into a destructive fire by an effective coating.

One piece of hot metal can easily start an inferno.

Structures prone to deck type fires can frequently be identified when consideration is given to, but not restricted to, such factors as:

- Braking requirements of territory
- Track curvature
- Speed limits
- Activity normally present—switching, etc.

Many railroads have elected to afford protection to their major main line structures for obvious reasons.

Preparation for treatment

To obtain maximum adhesion of coatings to the wood, large accumulations of dust or oil, loose coatings, splinters, protruding tie pads or other debris should be removed from surfaces to be coated. To avoid delay, this work should be started well before spraying begins. This particular coating can be sprayed directly over timber wetted by dew or light rain. Pools of water should be swept off.

Equipment needed

Typical complement of equipment used is:

1. A complete air break up type spray unit.
2. One push car.
3. Two lengths of timber at least 12 feet long for rolling drums and loading push car.
4. Tools and supplies such as:
   Pipe wrenches, crescent wrench, pliers, screw driver, drum opener, gasoline, compressor oil, funnel, water, brooms, scrapers, gloves, rags, hand cleaner.

This coating can be sprayed directly from the drum with a low pressure spray unit. The unit consists of:

A Briggs & Stratton powered gas compressor weighing about 100 pounds and rated at 20 CFM at 20 psi, along with all required plumbing, gauges, hoses, etc., all of which are available on either a rental or purchase basis.

Materials and equipment should be organized beforehand to permit maximum working time on the bridge by the crew when spraying commences. If a set-off is available or can be built near the end of larger bridges, spray equipment and material can be loaded onto the push car and assembled ready to spray when the track is clear.

The spray equipment assembled and drum pressure adjusted to the recommended 8-10 psi and tested before moving onto the bridge.

How coating is applied

The project should be planned to permit the sprayman to work continuously. Areas ahead should be clean and unobstructed, and the material should be pre-mixed — for minimum delays mean maximum production. It is best to establish a spray pattern to cover one width of bridge deck such as between rails or between rail and guard timber, then travel continuously along the bridge, repeating the pattern from tie to tie. The following method has been found to be the most efficient, and will produce a uniform coating that will give best performance.

The object is to spray all timber with two passes at 45° spray angle. Coverage is 25 sq. ft. per U.S. gallon at 45 mils dry film thickness.

If any portion of the substructure is to be coated, it should be done first to avoid working over freshly applied materials. Longer air and material hoses may be required.

Spray exposed top surfaces of all caps first, then barrel platforms, utility supports, and walkways, if specified.

Next spray top surfaces of timber stringers between ties plus 2″ up the side of ties over stringers.

Apply first pass to guard timbers or lining timber with the gun held outside the guard timber and the spray angle set ahead, down and inward at 45°, coat the upper surface of the guard timber feathering down its outer edge. Move ahead slowly from one end of the bridge to the other. All overspray should land on the ties. If no guard timber is present, use the same procedure, feathering down the ends of the ties and adjusting the gun angle obliquely to ensure no overspray.

With the spray angle set ahead and down at 45°, coat the top of ties adjacent to the guard timbers feathering onto material applied earlier. **Maintain uniform aggregate film thickness.** Again, no overspray should result.

Ensure that passes adjacent to rails cover any tie surface exposed at the ends of tieplates.

Keep spray pattern adjusted to ensure that every recess or crevice where a fire source may lodge is adequately coated.

When spraying with two guns, duplicate spray patterns on opposite sides of the bridge if possible. Typically, the first pass might be along both guard timbers simultaneously, then continuing back and forth over the full length of the bridge as described before. On the final pass, both guns will be side by side, spraying the center of the deck between rails.

Continue in this fashion until the entire deck has received one pass at 45° spray angle in one direction.

Apply the second pass by repeating this procedure with the gun at a 45° spray angle in the opposite direction. When complete, a uniform coating will have been applied to the upper surfaces of ties, two to three inches down the sides of ties, and the upper and inner surfaces of both guard timbers.

Many combinations are practicable as long as the second coat ultimately goes on in the **opposite direction** and maximum drying time is allowed between coats.

Check film thickness when dry, and respray where necessary to obtain minimum recommended total dry film thickness of 45 mils.

This procedure involves a great deal of movement over the bridge, but keeps the gun operating at full capacity while the sprayman adjusts his walking speed, or, the speed of the push car is adjusted, to obtain correct coverage. Do not spray back and forth from one side of the bridge to the other, or uneven application and overspray losses will result.

Finishing steps

At the end of the day, salvage material from used drums, and pump 10-15 gallons of water from a clean drum through the system to flush out the lines and gun.

While still wet, the material can be readily flushed off equipment with water. If allowed to dry, it is very difficult to remove, even with strong solvents.

When properly applied, this coating will provide a minimum of 10 years of protection. Additional applications on a cyclical basis can provide indefinite protection.

Thank you, Mr. Hyma.

Are there any questions?

This concludes the symposium on fire retardation.

I wish to thank the distinguished gentlemen who participated in a very informative and interesting program.

President Rankin: For your most interesting and informative presentation, the Association wants to thank you gentlemen. I am sure you will be available to those who have a special interest, for further discussion.

Will Mr. Iwinski please come forward to present the last of our Special Subjects reports.

Mr. Iwinski: The Sponsor for the Special Report on "Maintenance of Branch Line Bridges" is Mr. Budzileni. Will he please come forward to present the Chairman.

Mr. Budzileni: Chairman of this report is Mr. E. C. Patterson, Manager of Structures, Chicago & Northwestern, Boone, Iowa. He was assisted in the preparation of the report by members of the committee.

Mr. Patterson will now present the report.

Maintenance of Branch Line Bridges

SPECIAL SUBJECT COMMITTEE NO. 2

COMMITTEE—E. C. PATTERSON, *Chairman,* manager of structures, C&NW, Boone, Iowa; R. Y. CARPENTER, *Vice Chairman,* B&B Supervisor, Southern, Monroe, Virginia; T. L. FULLER, engineer bridges, SP, San Francisco, California; D. C. GOULD, assistant structural engineer, UP, Omaha, Nebraska; D. H. GUELLER, B&B supervisor, C&NW, Altoona, Wisconsin; W. J. GUNKLE, senior structural inspector, ConRail, Philadelphia, Penna.; W. R. HYMA, bridge engineer-system, AT&SF, Chicago, Illinois; E. T. JAATTEENMAKI, B&B master, CPR, Revelstoke, Canada; J. G. ROBERTSON, manager engineer design, B&LE, Greenville, Pa.; K. L. WAMMEL, assistant division engineer, SP, Portland, Oregon; J. W. DAVIDSON, assistant director bridge engineering, BN, St. Paul, Minnesota.

The level of maintenance required for bridges on lines designated as "branch lines" can be affected by many factors.

While annual tonnage is low, branch line bridges must often carry the same weight cars as main lines. The low earning power of these lines requires conserving existing structures to defer their replacement as long as is safely possible.

For the most part, these bridges are timber trestles that were built forty or more years ago. There are also a substantial number of old iron or steel spans of light design that may be anywhere from eighty to one hundred years old.

Some old arches and box culverts built of brick or stone can even exceed one hundred years of age.

A predominance of one type or another depends upon the conditions under which the line was originally built. For instance, an old main line that, because of changed traffic patterns, no longer carries the tonnage it had in the past may have a large number of permanent type bridges. Conversely, a little used branch line, built as a branch line with numerous timber bridges, now must handle heavier cars and longer trains. As can be seen, one of these lines probably will require more attention than the other.

Traffic frequency, speeds and load limits, as well as any expected increase or decrease in these, certainly will have as much a bearing on maintenance requirements as the previously mentioned items.

Geographical and climatic conditions are also important in determining criteria for maintaining any particular branch line. Mountainous or hilly country will certainly result in a greater number of higher and longer bridges requiring more attention than those one might encounter in a level, plain area. Dry conditions such as one might find in the western states would have a much less severe effect on bridges than the wet and/or icy conditions experienced in other portions of the country.

In order to establish annual maintenance requirements, it is absolutely essential to know the conditions of the bridges involved. This is best accomplished by an annual bridge inspection wherein all deficiencies are noted and recommendations for necessary repairs are made. Deficiencies are corrected at the time of yearly maintenance with the exception of emergency repairs which are done at once. The questionable future of many branches indicates a temporary rather than a permanent solution to problems for those particular lines. Major bridge reconstruction, which may entail driving piling, building timber trestles and, on occasion, constructing concrete abutments or piers and erecting steel spans or concrete slabs, may be required if further maintenance is no longer feasible or the basic line capacity is to be increased.

Inspection covers the observation and reporting of various conditions that may exist or develop on the bridge itself or along the right-of-way that may have an effect on the bridge.

The following general conditions should be observed during an inspection and recommendations made for remedial action:

Condition of rails, joints and fastenings on the bridge should be noted as well as the alignment of track with reference to the ends and center of each span. The number and size of defective ties should be noted as well as the condition of guard timbers and guard rails, walks and railings. Although ballast deck bridges on branch lines are not common, when they do occur, condition of deck material and ballast, effectiveness of waterproofing, if any, and depth of ballast should be checked.

When the approach to a bridge becomes low, additional impact is thrown on the bridge ends. A rail joint, located in the approach near the end of the bridge tends to aggravate the condition. This pounding, if permitted to continue, causes severe damage to the ties, requiring premature renewal. Responsible parties should be advised so the bridge approaches can be raised and the rail joint relocated.

Loss of ballast from ends of ties at bridges caused by inadequate backwalls, either from being too short or because of being badly deteriorated, may eventually cause unsafe track condition at the bridge ends similar to that just described. Repairs should be made or backwall extended to prevent conditions from worsening.

Accumulation of drift at bridges in large amounts may block the opening of a bridge allowing the water to back up and, in many instances, wash or cut into the embankment. In other cases, the extreme pressure that is created against the bridge may force it out of line. In other instances, even a small amount of debris can cause eddy currents that may undermine piers and abutments and loosen pile bents. Critical concentrations of drift may require immediate action to forestall possible damage and certainly all drift should be removed during general maintenance operations. If necessary, riprap may be required to restore safe conditions.

When poor line or surface on bridges is found, it may be the result of one or a combination of a number of conditions, such as, deteriorated stringers that do not provide sufficient holding resistance for line spikes, deteriorated or split and broken bridge ties, crushed timbers, usually caps or stringers, pier or abutment settlement and line bolts or spikes not properly installed or missing. It may also indicate settlement of bents or piers caused by unseen scour.

Heavy brush and weed conditions under and around bridges constitute a very serious fire hazard if not grubbed out or eliminated by a chemical eradication program.

It is very important to make a close inspection of all timber and hardware in timber trestles. Caps, stringers, ties and piling should be checked for signs of advanced deterioration or structural failure of the timber. If a general deterioration of bridge piling and caps can be detected far enough in advance, it may be possible to avoid the expense of re-driving the bridge for a good number of years by applying chemical preservatives to the affected timbers. Timber sway braces and backwall timbers, although not as important as the members carrying direct loads, should also be checked closely. Horizontal shear cracks in stringers and vertical splits in caps are critical and should be especially watched for. Loose hardware should be noted, particularly on the higher bridges where any looseness can be amplified and cause substantial movements during passage of a train.

Maintenance inspection of steel bridges is somewhat more involved and, in addition to many items just described, also includes the following:

Bridge seats on concrete or masonry piers and abutments should be checked for cracks and possible movement of stones and should also be checked for settlement or movement that may be caused by stream bed scour or a breakdown of the basic material. It may be necessary to underpin or solidify by grouting those that show deterioration. Timber pier components should be inspected on the same basis as timber trestles.

Anchor bolts and bearing need to be checked for soundness, proper functioning and cleanliness. Any deficiency in position of rockers, rollers or proper clearance between spans should be corrected.

Parts of metal spans damaged by blows from equipment, lading or floating objects should be identified by location and extent of damage noted for possible repair or future reference to determine if any progressive failure is taking place.

Girder spans and floor systems are to be examined for cracks or breaks in the metal, especially in floor beam and stringer connection angles and stringer flanges under tie bearings. Cracks may occur in webs of floor beams where bottom flanges do not extend under end connection angles. These locations should be checked closely.

Special note should be made of the condition of critical members of the old trusses, especially pin plates, hanger and chord eyebars where small hairline cracks may indicate the first stages of a failure.

Excessive pin movement and looseness of members may indicate a substantial amount of mechanical wear. Careful flame shortening of the eyebars, so that all eyebars in any one member are working in unison, will provide a temporary remedy until more permanent plans for work on the bridge can be developed.

All welds should be checked for cracks, especially those on very old metal where there is some question of its weldability. Loss of section due to rusting should be noted and, if severe enough to affect the span's carrying capacity, should be fixed.

Generally, steel or iron bridges on branch lines are not included in system paint programs. However, certain critical locations need to be watched and, if necessary, cleaned and spot painted to prevent further deterioration. Concrete slab bridges and culverts utilizing stone, brick or concrete are not very common on branch lines. When they do occur, chances are they are quite old and in various stages of deterioration and should be given a close inspection. Their appearance can sometimes be quite deceiving, with a solid looking member really in poor condition once a close inspection is made.

Bridge and Building maintenance crews assigned to branch lines to perform yearly maintenance usually consist of five men and a foreman. Depending upon the extent of their territory, they may be assigned camp cars and tool cars so that they may work efficiently on the more remote bridges.

Other basic equipment consists of, but is not restricted to, a two-ton truck with crew cab, air compressor and a complete line of air tools, primarily for wood construction. A portable electric generator with saws, drills and other tools may be furnished for making minor repairs. This equipment may be supplemented to also handle needs for any concrete or steel bridges on the territory. A full complement of hand tools, such as gas chain saws, axes, hammers, mauls, wrenches, etc. are also an important part of the crew's equipment. An essential piece of equipment is a hyrail truck crane, usually of 15-ton capacity, that is used to assist in moving caps, stringers and performing other heavy work that cannot be accomplished by manpower alone. It may be an integral part of the crew's heavy equipment or may be assigned on an "as needed" basis.

On those occasions when it is necessary to drive piling, place heavy spans or do other very heavy tasks requiring large equipment, a suitable machine, such as a combination pile driver-bridge derrick may be temporarily assigned to the crew.

Maintenance of branch line bridges is something practically all railroads are faced with in some degree. The various items just presented are basic requirements and, of course, need to be modified to suit any particular local conditions.

As branch line bridges get older and traffic increases, it is extremely important that bridge maintenance keeps pace to ensure safe and efficient train operations.

President Rankin: You are excused, with the thanks of your Association for an interesting and informative report. This concludes our program for today.

Do not forget the REMSA Banquet, to be held in these rooms starting at 6:30. Your paid-up dues and registration entitles you and your wife to a ticket.

We will start our Final Session tomorrow morning at 8:30 A.M. in this room.

I now declare this Session adjourned. (Gavel)

MORNING SESSION

September 28, 1977

President Rankin: The meeting will please come to order. The final session of the 82nd Annual Convention is now in progress. The total registration is 731. There are 118 ladies registered. The REMSA Banquet last evening was attended by ——. Will the Officers and Directors please come forward and our Business session will start. Information concerning the status of our organization will be presented by various reports. Please withhold any question on a specific report until such time as all reports have been presented. We will be pleased to attempt an answer to any question. Our Secretary, Mrs. Ann Wilson, was unable to attend our first session as her presence was required at the registration desk. She is with us today and will now present her report.

Secretary's Report

Report of Membership for Period September 1, 1976 to September 15, 1977

ACTIVE MEMBERSHIP			
Total Active Members September 1, 1976		416	
New Active Members since September 1, 1976		43	
Reinstated—Paid back dues		2	
Transferred from Associate		1	
		462	
LESS: Resigned account retirement	15		
Transferred to Life	9		
Deceased	2		
Dropped for non-payment of dues	24	50	
TOTAL ACTIVE MEMBERS			412
ASSOCIATE MEMBERS			
Total Associate Members September 1, 1976		94	
New Associate Members since September 1, 1976		11	
		105	
LESS: Resigned account retirement	6		
Deceased	2		
Transferred to Active	1		
Dropped for non-payment of dues	5	14	
TOTAL ASSOCIATE MEMBERS			91
LIFE MEMBERS			
Total Life Members September 1, 1976		155	
Transferred from Active Membership		9	
		164	
LESS: Reported deceased	6		
Transferred to Honorary	1	7	
TOTAL LIFE MEMBERS			157
HONORARY MEMBERS			
Total Honorary Members September 1, 1976	9		
Transferred from Life Membership	1		
TOTAL HONORARY MEMBERS			10
TOTAL MEMBERSHIP ALL CLASSES—September 15, 1977			670

September 1, 1976—Active	416	
Associate	94	
Life	155	
Honorary	9	Total 674

President Rankin: Thank you, Mrs. Wilson — Mr. Huffman, will you please present the Treasurer's Report?

Treasurer's Report

Period September 1, 1976 to August 31, 1977

Checking Account balance August 31, 1976		$ 5,643.99
RECEIPTS		
Dues	$ 3,528.00	
1975 Advertising	1,617.90	
1976 Advertising	2,465.00	7,610.90
		$ 13,254.89
DISBURSEMENTS		
Salaries (Secretary and Assistant)	3,763.20	
FICA (On payroll)	220.08	
Office Rent, Telephone, etc.	557.31	
Stationery and Printing	1,182.42	
Postage	764.92	
Office Supplies	258.54	
1975 Advertising (American Pub. Co.)	2,001.01	
1976 Convention Expense	650.45	
State of Illinois Unemployment Tax	1.73	
1976 Advertising (American Pub. Co.)	986.00	
Membership Certificates	208.73	
Federal Unemployment Tax	8.82	
Executive Board Meetings	293.08	
1976 Proceedings	1,074.68	
Contributions	325.00	12,295.97
Checking Account Balance August 31, 1977		$ 958.92
Homewood Federal S/L Assn. (5¼%)		$ 3,377.43
Homewood Federal S/L Assn. (6¾% 2/29/78)		6,468.23
Homewood Federal S/L Assn. (6¾% 2/2/80)		2,506.70
Homewood Federal S/L Assn. (6¾% 6/22/78)		3,330.18
		$ 16,641.46

Balance 8/31/76 — $20,340.05

President Rankin: Thank you, Mr. Huffman — Mr. E. R. Schlaf will now present the results of the audit by the Auditing Committee.

Report of Auditing Committee

TO MEMBERS OF THE AMERICAN
RAILWAY BRIDGE & BUILDING ASSOCIATION

Gentlemen:

The undersigned have examined the books of the Secretary and report of the Treasurer for the period from September 1, 1976 to August 31, 1977 inclusive and have found them to be correct as of the latter date.

Respectfully submitted,
E. R. Schlaf, Chairman
Henry F. Lucas
H. M. Wilson

President Rankin: Thank you, Mr. Schlaf.

Pause

Is there any discussion or questions regarding the report of the Secretary, Treasurer, or Auditing Committee you have heard?

If there is no further discussion, I will accept a motion that these reports be approved as given.

(Motion made and seconded)

The motion has been made and seconded that the reports of the Secretary, Treasurer, and Auditing Committee be approved. All in favor "Aye," opposed "Nay" — the motion is carried.

Will Mr. K. L. Wammel, chairman of the Resolutions Committee, please give his report.

Report of Resolutions Committee

Mr. President, at the close of this 82nd Annual Convention of the American Railway Bridge and Building Association, the Resolutions Committee offers the following resolutions:

BE IT HEREBY RESOLVED that the thanks of the Association be extended to Leroy Cronkhite II, Pastor, Central Church of Chicago for his message of spiritual assurance.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to the prominent speakers who gave of their time and shared their wisdom and experience with us, especially Mr. B. J. Worley, AREA president; Mr. W. H. Dempsey, president and chief executive officer, Association of American Railroads; Mr. Robert Parsons, associate administrator for research and development, Department of Transportation; Mr. Tracy Kelly, president, American National Bank, Bristow, Oklahoma; Dr. Joe Clark, wood pathologist; Mr. R. C. Grayson, president, St. Louis-San Francisco; Mr. R. F. Lawson, chief engineer, Amtrak; Mr. G. M. Titus, president Railway Tie Association; Mr. John Weber, special consultant, concrete ties; Mr. E. Potter, vice president Cedrite Corporation; Mr. R. W. Milbauer, Tremco Corporation; Mr. R. L. Standley, chief engineer Armco; Mr. J. W. Chambers, bridge construction engineer and Mr. R. L. Thielemier, designer, Missouri Pacific; Mr. J. H. Hines, president, Railway Engineering Maintenance Suppliers Association and to all members of the Railway Suppliers Association for the fine banquet and entertainment which we enjoyed last evening.

BE IT FURTHER RESOLVED that our thanks be expressed to Mrs. W. H. Rankin and Mrs. W. J. Cruse and their committees for their efforts in arranging registration and entertainment for our wives and to the untiring efforts of the ladies who assisted as hostesses.

AND BE IT FINALLY RESOLVED that the Association express its thanks to its Chairmen and their committees for their excellent work in preparing the reports which were presented at this convention; also to the Railroads who provided assistance at the registration desk, to the management and staff of the Hyatt Regency Chicago for their cooperation and hospitality as well as the members of our Executive Committee and to our President Mr. W. H. Rankin who spent so much of his personal time and effort in guiding the affairs of the Association over the past year.

Mr. President, we recommend these resolutions be made a part of the official record of this Association.

Respectfully submitted,
K. L. Wammel, Chairman
Resolutions Committee

President Rankin: Thank you, Mr. Wammel — will Mr. Gunkle, chairman of the Necrology Committee please give his report.

Report of Necrology Committee

To the President and Members of the
AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION:

It is with grief and regret that we report the known loss of ten (10) members through death during the past year. It is possible that other members have passed away during the year of whom we have no information. If you know of any, please report their names to the Secretary. The following have been reported since our last Annual Meeting in September 1976.

Active Members	**Title-Railroad-Location**	**Joined**	**Deceased**
G. F. Fritzinger	Asst. Engr. Norfolk & Western St. Louis, Mo.	1957	1976
J. J. Ridgeway (Past President)	Dir. Engr. Servs. Bessemer & Lake Erie Greenville, Pa.	1957	1977
Associate Members			
M. Baker, Jr.	Chrmn. Board M. Baker, Jr., Inc., C.E. Beaver, Pa.	1967	1977
L. D. Freeman	V. Pres. Sales Speno Rail Services, Inc. E. Syracuse, N.Y.	1969	1977
Life Members			
A. G. Beatty	Engr. Rdwy. Equip. C. & N.W. Chicago, Ill.	1957	1976
P. B. Collier	Supt. Scales Missouri Pacific Poplar Grove, Ark.	1938	1976
J. M. Giles	R.R. Sales Caterpillar Tractor Co. DeSoto, Mo.	1938	1977
J. C. Nichols	Bridge Engineer Louisville & Nashville Louisville, Ky.	1954	1977
E. W. Singer	B. B. Supvr. Norfolk & Western Ft. Wayne, Ind.	1923	1973
E. L. Smith	Gen. B.&B. Supvr. Southern Moselle, Miss.	1952	1976

Respectfully submitted,
W. J. Gunkle, Chairman

President Rankin: Thank you, Mr. Gunkle.

Pause

Each year three new directors are elected to serve our Association. After three years service these leave the Executive Committee. In recognition of the many hours spent for the benefit of our organization we wish to present certificates to those retiring directors. Will Messrs. Chambers and Novszewski please come forward. Joe—Stan—not as compensation for the many hours of your personal time devoted to the affairs of the Association but as an expression of the entire membership's appreciation I present these certificates of service to you.

Pause

The Nominating Committee is composed of the five most recent Past Presidents. At this time I would ask Mr. J. R. Williams, chairman of the Committee, to present the selection of that Committee for Officers and Directors to serve for the coming year.

Report of Nominating Committee

The Nominating Committee of the American Railway Bridge and Building Association respectfully submit to the membership the following slate of Officers and Directors with the recommendation that they be elected for the terms specified:

For President:	J. R. Iwinski, Chief Engineer-Public Works C. & N.W. Transp. Co., Chicago, IL
For 1st Vice Pres:	W. C. Sturm, Sr. Project Engr. E. J. & E., Joliet, IL
For 2nd Vice Pres.:	D. C. Gould, Asst. Str. Engr. U.P., Omaha, Nebraska
For 3rd Vice Pres.:	J. W. Chambers, Bridge Constr. Engr. M.P., St. Louis, Missouri
For Directors for term expiring in 1980	E. C. Patterson, Mgr. Strs. C. & N.W. Transp., Co., Boone, Iowa O. C. Denz, Supvr. Bldg. Mtce. C.M.S.P. & P., Chicago, IL W. S. Stokely, Bldg. Civil Engr. I.C.G., Chicago, IL 60601
For Secretary:	Ann Wilson
For Treasurer:	W. H. Huffman

Additional candidates may be nominated from the floor. The election will be held immediately following the program this morning.

Pause

Is there any other business to be brought to the attention of our membership? If not, the Business session is adjourned and the Officers and Directors are excused.

President Rankin: Continuing with our program, I call on Mr. Iwinski to introduce our next special feature.

First Vice President Iwinski: Our next presentation will be a Review of Procedures and Methods for Undertrack Tunnel Construction by Mr. R. L. Standley, Chief Engineer, Armco Steel Corporation-Metal Products Division.

Mr. Standley attended The University of California, Class of 1948, receiving a degree in Civil Engineering. He spent two years with the State of California-Bridge Department, joining ARMCO in Sacramento, California in 1950.

After spending two years in Civil Engineering-Corps of the U.S. Navy during the Korean War, he returned to ARMCO, advancing progressively to Division Engineer, Regional Engineer and, finally, Chief Engineer, at headquarters in Middletown, Ohio.

He is a member of the Transportation Research Board Committee on Buried Structures, AASHTO Committee on Flexible Structure Design and various technical committees of Trade Associations.

He is married and has three grown offspring.

Mr. Standley.

Review of Procedures and Methods for Undertrack Tunnel Construction

By R. L. STANDLEY

Chief Engineer, Armco Steel Corp., Metal Products Division

R. L. Standley

(At this time Mr. R. L. Standley, Chief Engineer at Armco Steel Corporation, presented an in-depth review of procedures and methods for undertrack tunnel construction.)

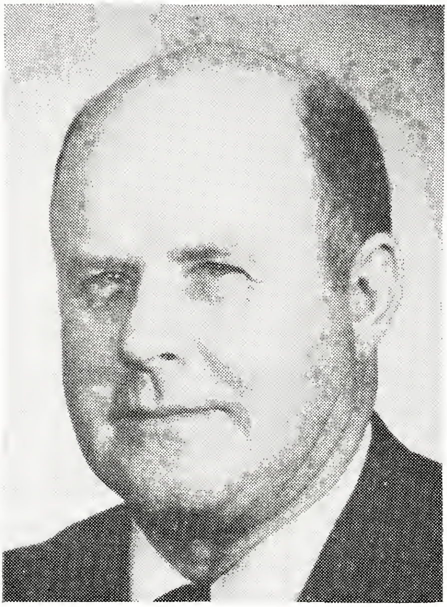
President Rankin: Thank you, Mr. Standley, for a most informative presentation on a very interesting subject.

As the final special feature presentation we have called on one of our Directors to inform us about the Missouri Pacific Concrete Products Yard Facility. Mr. J. W. Chambers, bridge construction engineer, Missouri Pacific R.R. will be giving us the overall picture while Mr. R. L. Thielemier, bridge design engineer of the same company, will cover the design aspects.

MoPac Concrete Products Yard

By J. W. CHAMBERS

Bridge Construction Engineer, Missouri Pacific, St. Louis



J. W. Chambers

Mr. President, Members, Guests.

I am happy to be here today and wish to thank you for the privilege of talking to you about the Missouri Pacific Concrete Products Yard at North Little Rock, Ark.

Mr. Rankin made me an offer I couldn't refuse.

Concrete trestles standardized

To begin, this is the Missouri Pacific Railroad's standard reinforced concrete trestle. They come in all lengths, but are always the same shape. Of course, the advantages of standardization in concrete are the same as those in timber structures in that the components are the same for all bridges and that it lends itself to standardized equipment, tools, supplies and very importantly, standardized construction methods and procedures, as well as the possibilities of stock that will not deteriorate.

As with timber, we can predict with some degree of accuracy production and construction costs based upon past performance and volume. And, of course, in the end we have a superior structure.

At present we have 7725 bridges on the Missouri Pacific system. Of these there are 45 miles of steel bridges, 48 miles of concrete bridges and 92 miles of timber bridges.

Use of standardized trestles Began in 1925

The policy of renewing timber trestles with standardized reinforced concrete trestles was begun in 1925 when the first one was built by a contractor. The railroad subsequently bought the contractor's locomotive crane and formed its own system bridge construction gang for the sole purpose of building concrete trestles.

(The originator of the idea is credited with the remark that we would not need concrete if we could bore a hole through the length of every timber pile prior to treatment.)

Now, that same concept is being used by letting time and nature provide the voids and treating the piling in place.

Later more system bridge gangs were formed and, at first, all piling and girders were formed, cast and cured at each site. After a few gangs had been established in about 1932 it was decided that a central casting yard mass-producing concrete piling and slabs would be more efficient. A gang at North Little Rock, Ark. was established for this purpose. Although there is a cost of shipping piling and girders, there is also a cost of shipping and properly storing sand, gravel, cement and water.

In addition, one set of forms-steel does the job for all of the gangs of which there have been as many as 10 working at one time on concrete trestles with contractors from time to time.

Naturally, with the volume of timber trestles on this railroad at that time, it was not possible to keep up with all timber bridge renewals in concrete only, so that for many years renewal of timber bridges was with both timber and concrete. Happily, for several years now we have been able to handle all timber trestle renewals in concrete. There are still 92 miles of timber bridges on this railroad, which, if we were to construct a mile per year, would take 92 years.—Job security!

We still occasionally build timber trestles, but only a few hundred feet per year. These are industry tracks, branch lines, sidings, the future of which is always doubtful. Also short 2- and 3-panel timber trestles are frequently renewed in kind.

Fortunately, each succeeding top management team has, after thorough study, continued concrete trestle policy. Our present management has not only continued the policy, but taken an active part and interest in improving, upgrading and modernizing our operation. The President and Chairman of the Board frequently inspect the Concrete Products Yard.

Missouri Pacific yard redesigned For more efficient use

During the latter part of 1972 and the first part of 1973 we redesigned the entire yard. At the same time we purchased new pile forms and started producing pre-stressed piling instead of conventionally reinforced piling. Originally the yard, track and buildings just evolved and grew as needed without plan. Buildings were from old S.H. material begged, borrowed or stolen. Six wooden buildings were replaced with a new large steel building.

The track layout was changed for more efficient use of the land after urban renewal took about three acres with 15,318 L.F. of track in the Concrete Products Yard and 15 turnouts.

The original position is shown by the dotted lines and the present position is shown by the solid lines. The new yard is planned for everything to be exactly where it is for several reasons, some of which I have forgotten, but at the time of planning and studying there were reasons for everything to be where it is today.

All of the work areas are centrally located. The boiler house, which contains two automatically controlled soap oil/gas fired boilers is located between the pile and girder tables and midway between the lengths. We steam cure our pre-stressed products. The office is in the west end of the new steel buildings and has a clear view of the primary working areas. The east ¾ of the building houses all those items that require shelter and work areas for rainy day work.

The ironworker shop, where we do fabricating for steel bridges lies at the opposite end of the casting area from the office and warehouse.

The storage of all items are on the perimeters of this main area, their proximity depending upon frequency of access requirements. For example, reinforcing is closest, then piling, then girders and beams and fairly well mixed up with these on the tracks of the outer perimeter is S.H. timber and miscellaneous equipment. A single track is used where light equipment and materials are stored. For piling a two track system is used so that the crane can move alongside the cars to load the piling. A three track system is used for girders so that cars to be loaded can be put onto the center track and be loaded by the crane from the track on either side.

We cast 24" octagonal piling. In 1973 when we completed yard alterations and built a new pile table for casting pre-stressed concrete piling we maintained production of conventionally reinforced piling and girders. The only way this was accomplished was by accumulating a large stock prior to our alterations to keep casting to a minimum during these alterations. We can cast piling in any lengths up to 75 ft. long. The design limits picking lengths longer.

Though we can cast in any lengths we cannot predict what lengths to cast right to the foot. It would also be impractical to stock is so many lengths, so we stock in lengths of from 25 to 65 ft. long in 5 ft. increments.

In 1965 we changed the design of our concrete girders from a slab type to a "T" type — still of conventional reinforced concrete. That was our first major change in about 35 years. The "T" section may not be as substantial a section as that old full slab, but it is very adequate and does what it is supposed to do. It would not stand up as well under conditions of a train wreck, but we decided that there would be no wrecks on concrete bridges.

The "T" section has provided distinct advantages. No. 1 is longer spans. No. 2 is less weight. Our 28 ft. girders weigh about 23 tons and the old style slabs weighed 27 tons. There is less concrete for the same lineal feet of girders and as a general rule we eliminated 1/3 of the field cast concrete and 1/3 of the piling required for the same length of bridge as the old style. Where we previously had panel lengths of from 14 ft. to 24 ft. in 1-ft. increments, we went to panel lengths of 24, 26, 27 and 28 ft. lengths as standard with an occasional odd length made specially.

In both style of girders the panels are on three pile bents. This expedites construction as it minimizes shifting the deck to drive the concrete piling.

This year we made another move forward. We built a new casting table and bought new forms to change from conventionally reinforced concrete girders to pre-stressed concrete girders. We have maintained essentially the same shape, but this is our third generation of concrete girders. These are made in any lengths up to 28 ft. We have eliminated the necessity of stocking the very heavy longitudinal re-bars for each length of girder both straight and bent. All we require now are the light stirrups and light longitudinal bars which are the same for all girders.

The Concrete Products Yard serves five system bridge construction gangs engaged in concrete construction and two system steel bridge repair gangs all working the year around. We also contract work and furnish the contractor with piling and girders. We have, at various times upon request, furnished other railroads with our concrete piling and girders when our own schedule permitted.

Starting up costs for a concrete products yard like ours would be considerable. However, that is just about what we did in 1972 when we re-built, except for the land and equipment. Most railroads would already have land available as we did, and a good share of the equipment.

As mentioned, we had to keep supplying field forces while the entire yard and track layout was moved and replaced. This entailed moving several hundred concrete piling and girders, steel spans of all sizes, timber and other miscellaneous items, not once, but several times each. All rail, ties and turnouts were replaced with good S.H. material and top grade crushed rock ballast.

Requirements for products yard

To give you some idea of what is required for a products yard, depending upon how large you need to be, consider the following:

We have: 13 acres of land
3 miles of track
15 turnouts
1 metal bldg. office and warehouse
Girder casting table and forms
Pile casting table and forms
Other misc. tables and forms
Boiler house
Tractor
Tensioning equipment
Loco. crane
Air compressor

Welders
Power tools
Misc. equip.
Supplies of all kinds
To name most of the requirements.

Our land is about in the center of the North Little Rock, Little Rock area, as you can see by the skyline.

Not including cost of land and track, the cost of this list is in the area of several hundred thousand dollars.

Our girder forms are 305 ft. long.

Our pile forms are 340 ft. long.

In 1972 we organized a new bridge construction gang. The starting cost of that gang was roughly $300,000, but we had recaptured a large part of the cost of a crane from a contractor who had been working for us continually for two or three years.

Today, the starting costs of a gang would start at $400,000 for a 50-80 ton locomotive crane alone. I like to impress upon the foremen their responsibility, and I do so at every opportunity. We have a program of schooling M/W foremen potentials. When I talk to them I make them aware of the fact that, including the value of the new bridges they build, they have an annual responsibility of about $1 million. Strictly B & B maintenance gangs would be considerably less, but nevertheless substantial.

Ready-mix concrete used

We do not mix our own concrete at the products yard. We have an arrangement by which a ready-mix firm furnishes the aggregate, mixes and delivers the concrete into our forms. We furnish the cement to them in bulk carload lots.

The casting tables are so arranged that the ready-mix trucks can run alongside the forms to dump concrete as well as the locomotive crane that handles the product.

One thing I have not been successful in doing is to delete the word "pour" from our vocabulary. I can't even get it out of my own. We cannot afford, in pre-stressing, to pour concrete — we want it "placed," especially where high strength concrete is a necessity. However, I do get the concrete vibrated "in place." We use 5000 P.S.I. concrete. By vibrating in place, I mean when the concrete is placed in the forms from the truck, vibrating is held behind far enough so that no vibrating influence reaches the edge of the concrete causing it to move laterally down the form. It is compacted down in the form because that is the only way to go. If the concrete is so wet that it "pours" easily, it is too wet and does not compact and become dense as good concrete should.

Using both pile tables we can make three production runs per week of piling. We can make four production runs per six weeks of girders. This production can be increased to one run per week. Each run on a pile table yields five to 13 piling. Every girder table runs yields 10 girders or five panels.

These are maximum runs right now, as we can make the maximum of pile or girders, but not both. At present we are not keeping the forces required for maximum production because our bridge program does not require it.

The pile table consumes approximately 5550 lin. ft. of ½" strand per run regardless of lengths of piling. The girder table uses 15,550 L.F. of strand each run. When casting, the whole length of the tables are used. The extras that result are put in stock and used shortly. Sometimes deliberately designed into the next bridge. If we did not pour the entire table at a time, thousands of feet of strand would be wasted over a period of time. One of the advantages of standardization is that nothing will be wasted.

It is essential that we have a stock on hand of all standard lengths of piling and girders, and accumulate piling and girders for specific projects in advance. You can readily see what happens if we have a low stock of each length of piling and all five gangs ordered the same length of piling at the same time. It happens now with two or three gangs several times a year. When we run out of a particular length we have to send the next longest length in stock which means excess cutoff wastes at the bridge site. We seem to be constructing many more short bridges now than long ones. This frequently creates simultaneous demands upon girders also. They have to be accumulated in advance.

This is the new pre-stressed girder table. An activity list of a pile or girder run would sound like this: "about"

1. Apply form release.
2. Place headers.
3. Place spiral or stirrups.
4. Thread strands.
5. Take up slack and fasten strands.
6. Set headers.
7. Apply initial load to strands.
8. Establish reference marks for elongation.
9. Apply full tensioning load.
10. Measure elongation.
11. Seat strand anchors.
12. Tie spiral or stirrups.
13. Place other R/F steel and tie.
14. Place concrete and finish.
15. After initial set place cover.
16. Apply steam.
17. Next day break cylinders.
18. Detention.
19. Remove pile or girders.
20. Clean up rubble and forms.

There are other products also.

We cast a solid concrete backwall for timber trestles. We cast a ballast retainer for previously constructed concrete trestles. We cast a ballast retainer for previously constructed concrete trestles where track raises over the years have resulted in ballast running off the side of the bridges.

We store S.H. deck plate girders, thru plate girders, beam spans and miscellaneous beams of all sizes. Most have to be altered or require repairs before being re-used.

We keep S.H. timber, emergency timber and F/W pile on hand.

Equipment not in immediate use is stored.

One of the things we found in prestressing was that spools of strand require containment. They can come undone like a watch spring.

To conclude:

I would like to remark that it used to be said we had an advantage in that we started out and became established when everything was cheap. That is not so now.

Everything is modern money. The Concrete Products Yard is all new since 1973. The crane is only 10 years old. All of the gangs are equipped with modern tools and equipment.

As to the future, I think we'll be getting into pre-stressed concrete caps for timber bridges. As you all are aware, the quality of timber, especially caps, is not nearly what it was years ago. Therefore, we cannot expect, and are not getting, the service life from timber today that we got from those bridges built 40-50 years ago, that are coming up for renewal today. Renewals will be sooner from now on.

Thank you very much for your attention.

I would now like to introduce to you Mr. Ron Thielemier, structural designer, who designed our P/S girder. He will give you more details on the girder.

* * *

Design and Production of Pre-stressed Concrete Girders

By R. L. THIELEMIER

Designer, Missouri Pacific, St. Louis

Evolution of pre-stressed girder

One particular operation of interest in our Concrete Products Yard is the casting of pre-stressed concrete girders. I will take a few minutes to discuss the evolution of the pre-stressed concrete girder on our Railroad, its design and its manufacture.

The evolution of the concrete girder, as a standard replacement span on our Railroad, began in 1925. This original girder is called a "flat slab" girder because of its shape. It takes two sections side by side to support the track. We used this girder until 1965 with a few modifications and revisions. The "flat slab" was a bulky girder limited to a length of 24 feet because of its weight —26.1 tons or 2,180 pounds per foot.

In 1965, a major new design was completed and thus evolved our "T Section." This conventionally reinforced girder has a greater depth of section, making better use of the reinforcing steel and concrete properties. The "T Section" has a curb cast monolithically on top of the flange to retain the track ballast. The improved design and cross section reduced the weight of our concrete girder 620 pounds per foot resulting in increasing the length to 28 feet. A length of 28 feet has a desirable weight and radius that can be handled by our locomotive cranes as well as a length and resulting load our three pile bents can support. At this time we chose standard length girders of 24, 26, 27 and 28 feet. These lengths are sufficient to handle the "spacing in" of new concrete bents in existing timber bridges that need replacing with a minimum of falsework. Another reason for choosing four lengths was to keep our inventory of prefabricated reinforcing steel at a minimum.

As time passed and with favorable cost savings realized by pre-stressing our 24 inch octagonal concrete piles, we investigated the possibilities of pre-stressing our "T Section." This cross section is considered, as we call it, "substantial," with a good web section to carry service loads with a minimum of bounce and/or deflection — thus giving it a longer life. Therefore, in evaluating a new pre-stress design we used our previous "T Section" configuration. We investigated voiding the section but concluded it would be more costly to construct the void and hold it in place than to fill the void with concrete. The void was a cardboard egg carton type that would have required two man hours to construct and, with the foreseeable problems of holding the void in place, was judged unacceptable. The void was investigated only as a materials saving method since the weight of the girder is not a lifting problem.

One particular advance in pre-stressing that aided our design was the 270 KSI strand, which increased the initial pre-stress by approximately 15 percent over ASTM grade. The Missouri Pacific Railroad Company "T Section" design, in particular, needs this extra pre-stress capacity to help pre-compress our massive section with a reasonable number of strands in order to carry all applied loads and resulting stresses. Our new pre-stressed girder is designed for Cooper E80 live load and full impact.

Fundamentals of pre-stress design

It may be helpful to explain the fundamentals of pre-stress design. Basically, the stresses in the bottom fibers are calculated for applied loads, that is, dead load of girder, ballast and track, live load and impact. The loads carry ultimate safety factors of 1.9 for dead load and 2.3 for live loads by AREA specifications. The object of pre-stress design is to pre-compress the girder with enough force to offset the design loads and ideally bring the bottom fiber stresses to zero under full load. In conventionally designed girders we design in bending only to carry this ultimate load. In pre-stress design we must design for various loading stages.

1. Initial pre-stress + weight of girder
2. Final pre-stress + weight of girder + ballast + track
3. Final pre-stress + dead loads + live loads + impact

Each intermediate loading stage must be within design specifications.

It seems simple enough to pre-compress the whole section uniformly so that the center of gravity of the pre-stressing steel coincides with the neutral axis of the concrete section. But we must remember that the addition of design load stresses will increase compression in the top flange as well as create tension in the bottom of the web. AREA specifications limit compression to 2,000 psi for 5,000 psi concrete. Therefore, we can readily see that two conditions must be met — zero of compression in the bottom flange and no more than 2,000 psi compression in the top flange under design loads. Keeping these two conditions in mind, we design so that the center of gravity of the pre-stressing strands falls below the neutral axis of the concrete section. This results in an eccentricity between strand center of gravity and concrete section neutral axis. This serves the dual purpose of pre-compressing the bottom fibers of the section to carry design stresses and causes very small compressive stresses in the top fibers. The final stresses in our 28 foot pre-stressed girder under full load are 1,083 psi compression — top fibers and 6 psi compression — bottom fibers. Diagram Number 1 illustrates the various loading stages.

Pre-stressing saves money

As I mentioned earlier, a major factor that influenced our decision to pre-stress our concrete girder was economics. We learned that pre-stressing our piles saved us money, approximately $1.00 per foot. A few calculations showed we could also save money by pre-stressing our "T Section" girder. The major money saving item in converting from the conventionally reinforced girder to

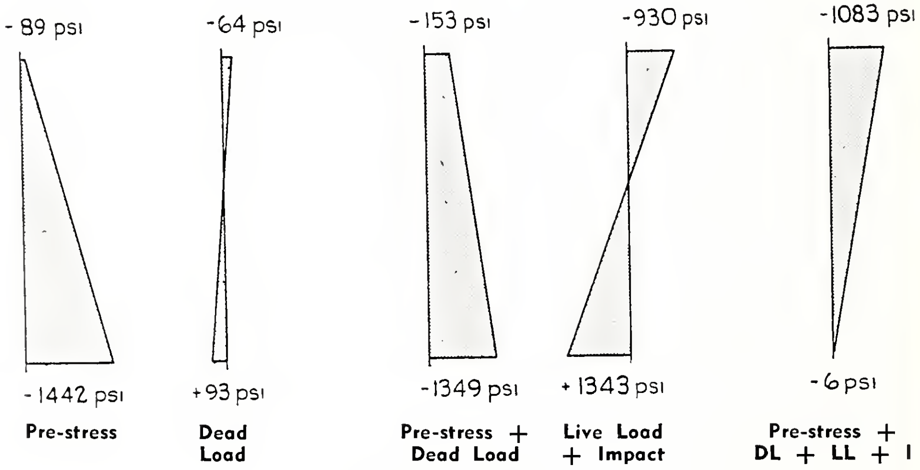


DIAGRAM NUMBER 1

the pre-stressed girder is reinforcing steel. Figures show a savings of $240 per 28 foot girder. This figure compares pre-stressing strand and conventional stirrup reinforcement in our pre-stressed girder against reinforcing steel in the conventionally reinforced girder. We figure a slight savings in labor, a moderate increase in quantity and therefore cost of concrete, producing a net result of a $182 savings per 28 foot girder. Again, as with our "flat slab," it takes two girders to support a track which converts into a savings of $364 per 28 foot panel or $13.00 per track foot.

Our potential savings, running at full capacity in our Concrete Products Yard, is $69,000 per year.

Manufacturing problems solved

The manufacture of our pre-stressed "T Section" was another challenging design problem. The amount of force required to pre-stress all the strands is 1.34 million pounds. Mr. Chambers, our Concrete Products Yard Foreman and myself, knowing that the pre-stressing bed and the procedure for pre-stressing our girder was going to be a major design problem in itself, visited local pre-stressing plants. We discussed various problems we anticipated and received helpful information. Invaluable information and pre-stressing technique was learned by first pre-stressing our piles. They were of simpler design and full attention was given to safety and methods of reducing labor to a minimum. Using these ideas with basic design calculations, we arrived at an acceptable solution.

Our pre-stressed concrete girder requires a maximum of 46 strands for 28 foot lengths with an initial pull of 29,100 pounds each, resulting in a total force of 1,338,600 pounds.

We have a system of double checking the amount of force in each strand. First, the hydraulic jack has a dial indicator showing pounds of pull in the strand. The second system, which is more reliable, figures the force by measuring elongation. The elongation required in the strand is calculated from the equation $\triangle = PL/AE$. Everything is known on the right-hand side of this equation, therefore, the elongation required is readily calculated. Our strands are initially marked and pulled the proper distance to provide the elongation calculated resulting in the required P = 29,100 pounds (70% of ultimate). As a check, each way of measuring the amount of force in a strand must be within 10% of each other.

A 300 pound rolled beam did not meet strength requirements for 1,338,600 pounds of force, so we designed a built-up 36" deep section using 1½ inch flanges and a 1¾ inch thick web with stiffeners. The billets required to transfer loads to these end posts are 8" thick. This was accomplished by keeping the two end posts at a minimum distance apart (35 inches) and passing some strands through holes in the flanges. Anchoring the end post was another problem. We used a block of concrete at each end that was 12 feet deep, 12 feet wide and approximately 25 feet long. We embedded our end posts 10' - 6" into this block of concrete. To prevent this massive block of concrete from differential settlement we drove four steel 12" H piles an average of 108 feet to rock. Finally to keep these end abutments from moving toward each other we blocked them apart with a T-shaped concrete beam at ground level. This beam also served as a foundation for our forms as well as a small working area for our men.

The length of bed is 309 feet face to face of end posts. The general length was arrived at by physical limitations in our yard and refined to provide for an optimum number of girder lengths with minimum waste of strand. With this length we are able to cast 10 or 11 girders (5 panels) depending on individual lengths, with a minimum of strand waste. Each foot of bed length not used results in a waste of 46 feet of strand. When multiplied by distances between headers, the length of strand wasted accumulates rapidly. Again, we try to schedule pours for maximum use of our bed, even if we cast an extra girder length for future use not called for in our present plans.

Another design feature that needed resolving to keep labor costs at a minimum was the stretching of 46 strands through 10 sets of headers. In the beginning we limited our design to parallel strands so as to avoid tie down for the draping of strands. This alleviated friction losses, threading problems and materials. Our original solution to this problem was building the headers in sections rather than one piece so that we could construct the headers around the stretched strands. This was a much better solution than threading each strand through a hole in each header. By this process we could place the bottom section of header, stretch the bottom row of 14 strands and proceed in this manner to the top of the "T Section." This solution proved slow and the Foreman and workers at our Yard provided a more workable solution by slotting the headers and reducing the number of pieces in each header from four to two. With the slotted headers, all strands except the top row can be stretched and the headers can slide down over these strands. The top row is then pulled and the last section set down over these strands and locked to our first section. Strand clamps hold the headers square and in place. Finally the slots are covered with straps preventing any bleeding of concrete. This procedure is now being used and refined.

After all strands and headers are in place, the conventional steel is tied to the strands; stirrups for shear and end blocks, and reinforcing steel to support the flange or floor of the bridge for the ballast section.

Concrete pouring is started early in the morning, steam cured, and reaches its transfer strength of 4,000 pounds per square inch usually the following day in the afternoon. The strength of the concrete is checked by cracking cylinders made during the concrete pour. Normally enough time is remaining that afternoon to de-tension our girders. This operation is carried out with care, making sure the correct strands are cut at each header, balancing the forces to prevent any damage to the girder. The girders are then lifted from the forms and stored in another part of our yard, allowing the cycle of pre-stressing to begin again. The complete cycle requires about one week. In the stored area the strands are cut flush with the concrete and waterproofing material is applied over the end of each strand to prevent deterioration.

As I mentioned earlier, we believe we have an excellent section to carry service loads, relatively maintenance free, fireproof, and by pre-stressing this section, have an economical bridge to replace aging timber bridges.

President Rankin: For a most interesting and informative presentation of your company's facility we wish to thank you.

◆

CLOSING SESSION

September 28, 1977

President Rankin: As my final appearance before you, I want to express my appreciation to many people. To the members of the Executive Committee, to the Chairmen and Committee members who have prepared our reports, to those who have favored us with special features, to the management of the company that employs me and made it possible for me to serve, and to my wife. The support of our Secretary and Staff has made it possible for me to guide the affairs of our Association. I truly appreciate all the help and kindness shown me by all. As I assume the position of Past President I ask and know you will give your continued support to the new incoming President.

You have heard the nominees as selected by the Nominating Committee. Are there further nominations from the floor. (Pause) There being no further nominees I will accept a motion that the list submitted by the Nominating Committee be elected. Mr. Iwinski as newly elected President of our Association, will you please come forward.

Acceptance

Mr. Iwinski: As your new President, I wish to express my deep appreciation for the honor you have bestowed upon me. You can be assured I will do my best to continue the fine tradition of my predecessors in this office. They have all done an exemplary job and have set a high set of ideals to be attained.

Through the years, we have been blessed with a succession of fine Executive Committees and I am certain this year's will be no exception.

As always, we have the usual tasks of keeping the Organization viable and active and in developing an interesting and informative convention program. All of us will have a chance to contribute to these important functions, including our newly-elected directors, as well as our "Old Heads."

Last year at about this same time, Mr. Rankin stated that a most important ingredient of any endeavor is PARTICIPATION. I think one of the major goals of this Committee will be to actively draw out the latent talent I am sure abounds amongst our members and get them to participate in the Special Subjects Reports. As a start along this path, we will have our first Executive Committee Meeting immediately after the close of this convention.

In my first official act, I want to recognize the hard work and long hours of service our immediate Past President, Mr. Warren Rankin, has contributed to the operation of this Organization. As a remembrance of his term as President and as an expression of our appreciation for his service, I am pleased to present him with this plaque. Warren will continue as a member of the Executive Committee as a past President and we will be able to benefit from his counsel on organizational matters.

Are there any other matters which should be brought before this Committee?

(A representative of REMSA presents a gavel to the President-elect)

I now declare the 82nd Annual Convention of the AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION TO BE ADJOURNED

(BANG!)

Will the members of the Executive Committee please assemble to the front.

In some unaccounted-for manner the following contribution of the Dow Chemical Company to the panel discussion of New Techniques for Concrete Restoration, at the 1976 Convention, was omitted from the Proceedings of that year. We regret the incident and apologize to Mr. A. A. Hill. We appreciate the effort of all who participate in preparation of our programs and know the information will prove beneficial to all. Therefore we are publishing this and suggest you cross reference the two proceedings with pencil notation for your future use.

Polymer Portland Cement Shotcrete

By A. A. HILL

Many of you have read, or will read, about cementitious compositions with the word "polymer" in their name. Three polymer-type compositions currently are being used or experimented with to repair or protect Portland cement concrete. One of these is polymer concrete (PC), which is a blend of resin or polymer and aggregate. It does not usually contain any Portland cement. A second type is polymer impregnated concrete (PIC) wherein new Portland cement concrete is impregnated with a chemical called a monomer, which is subsequently reacted to form a polymer in place. The type of polymer composition which Mr. Bryant talked about in his excellent slide presentation is polymer Portland cement (PPC) mortar or concrete. It is almost identical to the regular Portland cement mortars or concretes with which you are familiar, except that it also contains a polymer which has been added to the wet mix in the form of a special latex. The latex replaces part of the water normally used to mix Portland cement compositions.

Why use latex? Simply to correct some of the shortcomings of regular Portland cement compositions, such as low tensile strength, low compressive strength, high permeability to salts and other chemicals, low flexural strength, and poor adhesion to reinforcing steel and to cured concrete itself.

For example, latex can raise the tensile strength of a Portland cement mortar from 300 psi to as much as 900 psi, the flexural strength from 500 psi to 1500 psi, the bond-to-concrete strength from 200 psi to 600 psi, and the compressive strength from 5000 psi to 8000 psi or even more in the case of concrete compositions as opposed to mortar compositions. PPC also forms a strong barrier to penetration of water, salt water, and deicing salts, thus protecting reinforcing steel from corrosion caused by these products in the environment.

How does PPC work? As you probably know, ordinary Portland cement mortars and concretes never reach their full theoretical capabilities because they are full of microscopic cracks and pores after curing. One of the reasons for using low slump concrete is to try to prevent the formation of excessive microcracks in order to get higher strengths. Latex does essentially two things; it permits an initial low water-to-cement ratio while still retaining good workability, and the polymer in the latex bridges the microcracks in the cured mortar and concrete. This permits the concrete to attain much more of its theoretical strengths, and, in addition, makes it much more impermeable.

PPC Mortar and Concrete have been used successfully on bridge decks, runways, parking decks, etc. since 1957. PPC shotcrete for the repair of concrete bridges and other structures is in the stage of field development at this time.

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	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

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Secretary			F. O. Whiteman	A. G. Shaver
Treasurer			F. E. Weise	F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefting	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefting	K. L. Miner	W. A. Sweet	Martin Meyer

	1942-1943	1943-1944	1944-1945	1945-1946
President	G. S. Crites	J. L. Varker	J. L. Varker	N. D. Howard
1st V.-Pres.	R. E. Caudle	R. E. Caudle	R. E. Caudle	F. G. Campbell
2nd V.-Pres.	A. M. Knowles	N. D. Howard	N. D. Howard	J. S. Hancock
3rd V.-Pres.	N. D. Howard	F. G. Campbell	F. G. Campbell	E. H. Barnhart
4th V.-Pres.	J. L. Varker	J. S. Hancock	J. S. Hancock	W. F. Martens
Secretary	A. G. Shaver† Lorene Kindred‡ Elinor V. Heffern	Elinor V. Heffern	Elise LaChance	Elise LaChance
Treasurer	F. E. Weise	C. R. Knowles	C. R. Knowles	C. R. Knowles
Treasurer Emeritus		F. E. Weise	F. E. Weise	
Directors	M. Meyer	W. F. Martens	W. F. Martens	A. B. Chapman
	L. E. Peyser	A. L. McCloy	A. L. McCloy	W. A. Huckstep
	K. L. Miner	L. C. Winkelhaus	L. C. Winkelhaus	F. R. Spofford
	F. G. Campbell	E. H. Barnhart	E. H. Barnhart	Guy E. Martin
	J. S. Hancock	A. B. Chapman	A. B. Chapman	B. R. Meyers
	L. C. Winkelhaus	L. E. Peyser	L. E. Peyser	L. E. Peyser

† To November 1, 1952 ‡ To February 1, 1943

	1946-1947	1947-1948	1948-1949	1949-1950
President	F. G. Campbell	J. S. Hancock	E. H. Barnhart	W. F. Martens
1st V.-Pres.	J. S. Hancock	E. H. Barnhart	W. F. Martens	W. A. Huckstep
2nd V.-Pres.	E. H. Barnhart	W. F. Martens	W. A. Huckstep	Guy E. Martin
3rd V.-Pres.	W. F. Martens	W. A. Huckstep	Guy E. Martin	F. R. Spofford
4th V.-Pres.	W. A. Huckstep	G. E. Martin	F. R. Spofford	Lee Mayfield
Treasurer	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	C. R. Knowles	C. R. Knowles	L. C. Winkelhaus	L. C. Winkelhaus
Directors	Guy E. Martin	H. M. Harlow	Lee Mayfield	H. M. Harlow
	B. R. Meyers	H. B. Christianson	F. M. Misch	V. E. Engman
	L. E. Peyser	F. R. Spofford	W. D. Gibson	G. W. Benson
	H. M. Harlow	Lee Mayfield	H. M. Harlow	F. M. Misch
	H. B. Christianson	Franz M. Misch	V. E. Engman	L. R. Morgan
	F. R. Spofford	W. D. Gibson	G. W. Benson	J. A. Jorlett

	1950-1951	1951-1952	1952-1953	1953-1954
President	W. A. Huckstep	Guy E. Martin	F. R. Spofford	Lee Mayfield
1st V.-Pres.	Guy E. Martin	F. R. Spofford	Lee Mayfield	H. M. Harlow
2nd V.-Pres.	F. R. Spofford	Lee Mayfield	H. M. Harlow	J. A. Jorlett
3rd V.-Pres.	Lee Mayfield	H. M. Harlow	J. A. Jorlett	R. R. Gunderson
4th V.-Pres.	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	F. M. Misch	M. H. Dick	W. H. Huffman	M. H. Dick
	L. R. Morgan	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells
	J. A. Jorlett	J. F. Warrenfells	B. M. Stephens	G. Switzer
	M. H. Dick	W. H. Huffman	M. H. Dick	B. M. Stephens
	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells	W. H. Bunge
	J. F. Warrenfells	B. M. Stephens	G. Switzer	E. R. Schlaf

	1954-1955	1955-1956	1956-1957	1957-1958
President	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
1st V.-Pres.	J. A. Jorlett	R. R. Gunderson	W. H. Huffman	M. H. Dick
2nd V.-Pres.	R. R. Gunderson	W. H. Huffman	M. H. Dick	B. M. Stephens
3rd V.-Pres.	W. H. Huffman	M. H. Dick	B. M. Stephens	H. D. Curie
4th V.-Pres.	M. H. Dick	B. M. Stephens	H. D. Curie	
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhause	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	B. M. Stephens	J. F. Warrenfells	W. H. Bunge	G. W. Benson
	W. H. Bunge	H. D. Curie	E. R. Schlaf	J. M. Lowry
	E. R. Schlaf	J. M. Lowry	G. W. Benson	H. H. Matthews
	J. F. Warreafells	W. H. Bunge	J. M. Lowry	T. M. von Sprecken
	H. D. Curie	E. R. Schlaf	T. M. von Sprecken	W. H. Bunge
	J. M Lowry	G. W. Benson	H. A. Matthews	E. R. Schlaf

	1958-1959	1959-1960	1960-1961	1961-1962
President	M. H. Dick	B. M. Stephens	H. D. Curie	G. W. Benson
1st V.-Pres.	B. M. Stephens	H. D. Curie	G. W. Benson	J. M. Lowry
2nd V.-Pres.	H. D. Curie	G. W. Benson	J. M. Lowry	E. R. Schlaf
3rd V.-Pres.	G. W. Benson	J. M. Lowry	E. R. Schlaf	H. A. Matthews
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	L. C. Winkelhause	L. C. Winkelhaus	L. C. Winkelhause
Directors	J. M. Lowry	W. H. Bunge	H. A. Matthews	R. C. Baker
	R. C. Baker	E. R. Schlaf	M. J. Hubbard	R. H. Miller
	W. H. Bunge	H. A. Matthews	R. C. Baker	Shirley White
	E. R. Schlaf	M. J. Hubbard	R. H. Miller	H. M. Wilson
	H. A. Matthews	R. C. Baker	Shirley White	R. D. Hellweg
	M. J. Hubbard	R. H. Miller	H. M. Wilson	F. W. Hutcheson

	1962-1963	1963-1964	1964-1965	1965-1966
President	J. M. Lowry	E. R. Schlaf	R. C. Baker	H. M. Wilson
1st V.-Pres.	E. R. Schlaf	R. C. Baker	H. M. Wilson	R. D. Hellweg
2nd V.-Pres.	H. A. Matthews	Shirley White	R. D. Hellweg	J. W. DeValle
3rd V.-Pres.	R. C. Baker	H. M. Wilson	J. W. DeValle	W. F. Armstrong
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	E. F. Snyder	E. F. Snyder	E. F. Snyder
Directors	Shirley White	R. D. Hellweg	W. F. Armstrong	J. A. Goforth
	H. M. Wilson	F. W. Hutcheson	J. S. Ellis	E. R. Simmons
	R. D. Hellweg	W. F. Armstrong	J. A. Goforth	N. D. Bryant
	F. W. Hutcheson	J. W. DeValle	E. R. Simmons	A. R. Dahlberg
	W. F. Armstrong	J. A. Goforth	N. D. Bryant	J. S. Ellis
	J. W. DeValle	E. R. Simmons	A. R. Dahlberg	T. L. Fuller

	1966-1967	1967-1968	1968-1969	1969-1970
President	R. D. Hellweg	J. W. DeValle	W. F. Armstrong	J. A. Goforth
1st V.-Pres.	J. W. DeValle	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg
2nd V.-Pres.	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg	T. L. Fuller
3rd V.-Pres.	J. A. Goforth	A. R. Dahlberg	T. L. Fulle	N. D. Bryant
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	N. D. Bryant	J. S. Ellis	N. F. Lucas	W. H. Rankin
	A. R. Dahlberg	T. L. Fuller	W. L. Short	E. E. Runde
	H. F. Lucas	R. A. Youngblood	C. E. Wachter	T. A. Reynolds
	J. S. Ellis	H. F. Lucas	A. C. Jones	J. J. Ridgeway
	T. L. Fuller	W. L. Short	W. H. Rankin	J. R. Williams
	R. A. Youngblood	C. E. Wachter	E. E. Runde	J. W. Chambers
	V. D. Raessler	A. C. Jones	T. A. Reynolds	R. E. Frame
	W. L. Short	W. H. Rankin	J. J. Ridgeway	J. C. Hobbs
	C. E. Wachter	E. E. Runde	J. R. Williams	

	1970-1971	1971-1972	1972-1973	1973-1974
President	A. R. Dahlberg	T. L. Fuller	N. D. Bryant	E. E. Runde
1st V.-Pres.	T. L. Fuller	N. D. Bryant	E. E. Runde	J. J. Ridgeway
2nd V.-Pres.	N. D. Bryant	E. E. Runde	J. J. Ridgeway	J. R. Williams
3rd V.-Pres.	E. E. Runde	J. J. Ridgeway	J. R. Williams	W. R. Rankin
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	T. A. Reynolds	J. W. Chambers	R. K. Corbett	D. C. Gould
	J. J. Ridgeway	R. E. Frame	J. R. Iwinski	W. S. Stokely
	J. R. Williams	J. C. Hobbs	J. S. Pritchett	W. C. Sturm
	J. W. Chambers	R. K. Corbett	D. C. Gould	J. W. Davidson
	R. E. Frame	J. R. Iwinsky	W. S. Stokeley	C. A. Hughes
	J. C. Hobbs	J. S. Pritchett	W. C. Sturm	W. R. Hyma
	R. K. Corbett	D. C. Gould	J. W. Davidson	O. C. Denz
	J. R. Iwinsky	W. S. Stokeley	C. A. Hughes	R. C. McMaster
	J. S. Pritchett	W. C. Sturm	W. R. Hyma	W. E. Brakensiek

	1974-1975	1975-1976	1976-1977
President	J. J. Ridgeway	J. R. Williams	W. H. Rankin
1st V.-Pres.	J. R. Williams	W. H. Rankin	J. B. Iwinski
2nd V.-Pres.	W. H. Rankin	J. C. Hobbs	W. C. Sturm
3rd V.-Pres.	J. C. Hobbs	J. R. Iwinski	D. C. Gould
Secretary	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	J. W. Davidson C. A. Hughes W. R. Hyma W. E. Brakensiek O. C. Denz R. C. McMasters F. B. Lindsay, Jr. M. Noyszewski Jim Payne	W. E. Brakensiek O. C. Denz R. C. McMasters F. R. Lindsay M. Noyszewski W. C. Sturm W. J. Gunkle W. E. Halley K. L. Wammel	J. W. Chambers M. Noyszewski W. J. Gunkle W. E. Halley K. L. Wammel J. Budzileni B. J. King J. G. Robertson

HISTORICAL INFORMATION

List of Annual Conventions

No.	Place of Meeting	Date	Membership
1	St. Louis, Mo.	Sept. 25, 1891	60
2	Cincinnati, Ohio	Oct. 18-19, 1892	112
3	Philadelphia, Pa.	Oct. 17-19, 1893	128
4	Kansas City, Mo.	Oct. 16-18, 1894	115
5	New Orleans, La.	Oct. 15-16, 1895	122
6	Chicago, Ill.	Oct. 20-22, 1896	140
7	Denver, Colo.	Oct. 19-21, 1897	127
8	Richmond, Va.	Oct. 18-19, 1898	148
9	Detroit, Mich.	Oct. 17-19, 1899	148
10	St. Louis, Mo.	Oct. 16-18, 1900	143
11	Atlanta, Ga.	Oct. 15-17, 1901	171
12	Minneapolis, Minn.	Oct. 21-23, 1902	195
13	Quebec, Canada	Oct. 20-22, 1903	223
14	Chicago, Ill.	Oct. 18-20, 1904	293
15	Pittsburgh, Pa.	Oct. 17-19, 1905	313
16	Boston, Mass	Oct. 16-18, 1906	340
17	Milwaukee, Wis.	Oct. 15-17, 1907	341
18	Washington, D. C.	Oct. 20-22, 1908	368
19	Jacksonville, Fla.	Oct. 19-21, 1909	393
20	Denver, Colo.	Oct. 18-20, 1910	428
21	St. Louis, Mo.	Oct. 17-19, 1911	499
22	Baltimore, Md.	Oct. 15-17, 1912	524
23	Montreal. Quebec	Oct. 21-23, 1913	570
24	Los Angeles, Cal.	Oct. 20-22, 1914	586
25	Detroit, Mich.	Oct. 19-21, 1915	665
26	New Orleans. La.	Oct. 17-19, 1916	710
27	Chicago, Ill.	Oct. 16-18, 1917	704
28	Chicago, Ill.	Oct. 15-17, 1918	716
29	Cleveland, Ohio	Oct. 21-23, 1919	776
30	Atlanta, Ga.	Oct. 26-28, 1920	840
31	New York, N. Y.	Oct. 18-20, 1921	850
32	Cincinnati, Ohio	Oct. 17-19, 1922	865

No.	Place of Meeting	Date	Membership
33	Seattle, Wash.	Oct. 16-18, 1923	846
34	Kansas City, Mo.	Oct. 21-23, 1924	837
35	Buffalo, N. Y.	Oct. 20-22, 1925	759
36	Richmond, Va.	Oct. 12-14, 1926	750
37	Minneapolis, Minn.	Oct. 18-20, 1927	754
38	Boston, Mass.	Oct. 23-25, 1928	755
39	New Orleans, La.	Oct. 15-17, 1929	755
40	Louisville, Ky.	Oct. 21-23, 1930	713
41	Chicago, Ill.	Oct. 16-18, 1934	592
42	Chicago, Ill.	Oct. 15-17, 1935	547
43	Chicago, Ill.	Oct. 20-22, 1936	588
44	Chicago, Ill.	Oct. 19-21, 1937	566
45	Chicago, Ill.	Oct. 18-20, 1938	589
46	Chicago, Ill.	Oct. 17-19, 1939	546
47	Chicago, Ill.	Oct. 15-17, 1940	610
48	Chicago, Ill.	Oct. 14-16, 1941	594
49	Chicago, Ill.	Oct. 20-22, 1942	618
50	Chicago, Ill.	Oct. 20-21, 1943	597
51	Chicago, Ill.	Sept. 17-19, 1946	698
52	Chicago, Ill.	Sept. 16-18, 1947	651
53	Chicago, Ill.	Sept. 20-22, 1948	652
54	Chicago, Ill.	Sept. 12-14, 1949	676
55	Chicago, Ill.	Sept. 18-20, 1950	713
56	Chicago, Ill.	Sept. 17-19, 1951	676
57	Chicago, Ill.	Sept. 15-17, 1952	667
58	Chicago, Ill.	Sept. 15-17, 1953	666
59	Chicago, Ill.	Sept. 13-15, 1954	682
60	Chicago, Ill.	Sept. 19-21, 1951	625
61	Chicago, Ill.	Sept. 18-20, 1956	657
62	Chicago, Ill.	Sept. 23-25, 1957	769
63	Chicago, Ill.	Sept. 15-17, 1958	828
64	Chicago, Ill.	Sept. 15-17, 1959	863
65	Chicago, Ill.	Sept. 19-21, 1960	932
66	Chicago, Ill.	Sept. 18-20, 1961	968
67	Chicago, Ill.	Sept. 10-12, 1962	942
68	Chicago, Ill.	Oct. 14-16, 1963	887
69	Chicago, Ill.	Sept. 14-16, 1964	860
70	Chicago, Ill.	Sept. 13-15, 1965	829
71	Chicago, Ill.	Sept. 26-28, 1966	800
72	Chicago, Ill.	Oct. 11-13, 1967	799
73	Chicago, Ill.	Sept. 9-11, 1968	825
74	Chicago, Ill.	Sept. 9-11, 1969	746
75	Chicago, Ill.	Sept. 28-30, 1970	709
76	Chicago, Ill.	Sept. 13-15, 1971	719
77	Chicago, Ill.	Sept. 18-20, 1972	706
78	Chicago, Ill.	Sept. 17-19, 1973	750
79	Chicago, Ill.	Oct. 1- 3, 1974	683
80	Chicago, Ill.	Sept. 15-17, 1975	672
81	Chicago, Ill.	Sept. 13-15, 1976	833
82	Chicago, Ill.	Sept. 26-28, 1977	731

CONSTITUTION

ARTICLE I.

NAME

Section 1. This association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT

Section 1.** The object of this association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings, water service facilities, and other structures, by investigation, reports and discussions.

Section 2. The association shall neither indorse nor recommend any particular devices, trade marks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussion unless the same have received the endorsement of the association in regular session.

ARTICLE III.

MEMBERSHIP

Section 1.* The membership of this association shall be divided into four classes, viz: Members, life members, associate members and honorary members.

Section 2.* A member shall be a person in a position above rank of gang foreman in connection with engineering, construction and maintenance for railway bridges, buildings and water service facilities: or in the employ of a public regulatory body, a professor of engineering or architecture, a technical editor, a government or private timber expert, a consulting engineer, or an engineer in his employ, engaged in the engineering, construction and maintenance of railroad-related facilities or an engineer employed by a technical service or research and development organization, an officer or engineer of an engineering or scientific society or association whose aims and objectives are compatible with the aims and objectives of this association. Any person desirous of becoming a member shall make application upon the form prescribed by the executive committee, setting forth his name, age, residence and practical experience. He shall furnish at least three references to whom he is personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the executive committee, a majority vote being necessary in either instance.

Section 3.** To be eligible for a life membership a member must have belonged to the association for at least 15†† years and in general must have retired from active railway service due to age or physical disability. He shall have all the privileges of membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2, of this Article.

Section 4. Associates shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to co-operate with members in the study and development of improved practices in the construction and maintenance of bridges, buildings and water facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2 of this Article.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the unanimous vote of the members present at a regular meeting. They shall have all the rights of members except that of holding office and shall be exempt from the payment of dues.

Section 6. Any member guilty of conduct unbecoming to a railroad officer and a member of this association, or who shall refuse to comply with the rules of this association, shall forfeit his membership on a two-thirds vote of the executive committee.

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*Amended September, 1976.

** Amended September 20, 1948

†† Amended March 10, 1958.

Section 7. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

Section 8.** Only members shall hold office in this association, and only members and life members shall be entitled to vote in the election of officers.

ARTICLE IV.

OFFICERS

Section 1§. The officers of the Association shall be a president, three vice-presidents, a secretary, a treasurer and nine directors, who, with the most recent past president, shall constitute the Executive Committee.

Section 2. The past presidents of this association, previous to the most recent past president, who continue to be members shall be privileged to attend all meetings of the executive committee, at which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the executive committee without delay.

ARTICLE V.

EXECUTIVE COMMITTEE

Section 1.** The executive committee shall manage the affairs of the association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the association, and make all necessary purchases and contracts required to conduct the general business of the association, but shall not have the power to render the association liable for any debt beyond the amount then in the treasury plus accounts receivable and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the association.

Section 2. Meetings of the executive committee may be called by a majority of the members of the committee, providing 10 days' notice is given members by mail.

Section 3. Five members of the executive committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND TENURE OF OFFICE

Section 1. Except as otherwise provided the officers shall be elected at the regular annual meeting of the association and the election shall not be postponed except by unanimous consent of the members present at said annual meeting. The election shall be by ballot, a majority of the votes cast being required for election. Any member of the association not in arrears for dues shall be eligible for office, but the president shall not be eligible for re-election.

Section 2.§ The president, three vice-presidents, secretary and treasurer shall hold office for one year and the directors for three years, three directors being elected each year. All officers shall retain their office until their successors are elected and installed. A director elected for a three-year term shall not be eligible to serve two consecutive terms.

Section 3.† The term of office of the secretary and the treasurer may be terminated at any time by a two-thirds vote of the executive committee. Their compensation shall be fixed by a majority vote of the executive committee.

The secretary shall also serve as secretary of the executive committee.

Section. 4. The secretary and the treasurer shall be required to give bond in an amount to be fixed by the executive committee.

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* Amended October 16, 1941.

† Amended September 21, 1957.

§ Amended September 28, 1966.

ARTICLE VII.

MEMBERSHIP FEE AND DUES

Section 1.† Every member upon joining this association shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears, may be stricken from the list of members at the discretion of the executive committee.

Section 2.‡ A person stricken from the list of members because of non-payment of dues, upon written application may be reinstated as a member in his former class without loss of privileges, either upon payment of all back dues (which must accompany applicants) or at the discretion of the executive committee voting in the manner prescribed in Section 2, Article III.

ARTICLE VIII.*

LOCAL SECTIONS

Section 1.** Upon the application of ten or more members of the association residing in the same geographical district, or having offices therein, the executive committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this association as the section membership may adopt and the executive committee approve.

Section 2. The parent association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX.

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

By-Laws

TIME OF MEETING

1.** The regular meeting of this association shall convene annually during the month of September, the exact date to be fixed by the executive committee.

PLACE OF MEETING

2.** The place of holding the annual convention shall be Chicago, Ill.

3. It shall be within the power of the executive committee to change the location or time of the meeting if it becomes apparent that it is for the best interests of the association.

QUORUM

4. At the regular meeting of the association, 15 or more members shall constitute a quorum.

***DUES

5. The annual dues for the fiscal year ending August 31, and payable in advance, shall be as follows:*

Members, $7.00; Associate Members, $7.00.

DUTIES OF OFFICERS

6.† The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. He shall with the secretary sign all contracts or other written obligations of the association which have been approved by the executive committee. He shall render a detailed report at least three times during the year to the members of the executive committee, showing the financial condition of the association and its activities.

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† Amended October 17, 1940.
* Article adopted 1922.
** Amended September 20, 1948
‡ Amended September 21, 1957.
*** Amended September 15, 1965.

At the annual meeting the president shall present a report containing a statement of the general conditions of the association.

7. The vice-presidents in order of seniority shall preside at meetings in the absence of the president and discharge his duties in case of a vacancy in his office.

8.† It shall be the duty of the secretary to keep a correct record of the proceedings of all meetings of this association, and of all accounts, between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall pay all bills when properly certified and approved by the president and the treasurer, and make such reports as may be called for by the executive committee. He shall also perform such other duties as the association may require.

9.‡ The treasurer shall have charge of the funds, check all deposits as made by the secretary, sign all checks after they have been approved by the president, and invest all funds not needed for current expenses as directed by the executive committee. He shall report at each annual meeting on the condition of the finances.

NOMINATING COMMITTEE

10.# After each annual meeting the president shall appoint a committee consisting of five members. Two Past Presidents shall be members of this committee, one of whom shall act as Chairman. No other officers of the Association shall be appointed to this committee. This committee shall prepare a list of names of nominees for officers to be voted on at the next annual convention in accordance with ARTICLE VI of the Constitution, said list to be read at the business session of said convention. Nothing in this section shall be construed to prevent any member making further nominations.

AUDITING COMMITTEE

11.‡ Prior to each annual meeting the president shall appoint a committee of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

COMMITTEE ON SUBJECTS FOR DISCUSSION

12. After each annual meeting the president shall appoint a committee whose duty it shall be to prepare a list of subjects for investigation to be submitted for approval at the next convention.

COMMITTEE ON INVESTIGATION

13. After the association has adopted the list of subjects for investigation the president for the succeeding year shall appoint the committees who shall prepare the subjects for report and discussion. He may also appoint individual members to prepare reports on special subjects, or to report on any special or particular subject.

PUBLICATION COMMITTEE

14. After each annual meeting the executive committee shall appoint a publication committee consisting of three active members whose duty it shall be to cooperate with the secretary in the issuing of the publications of the association. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year.

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‡ Adopted October 17, 1940.
# Amended December 4, 1950.
† Amended September 20, 1948.
‡ Amended September 21, 1957.

ORDER OF BUSINESS

15.† Call to order by president.
Opening prayer or invocation.
President's address.
Report of secretary.
Report of treasurer.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Election of officers.
Installation of officers.
Adjournment.

DECISIONS

16. The votes of a majority of the members present shall decide any questions. motion or resolution which shall be brought before the association, unless otherwise provided. Unless specifically provided herein otherwise, all discussions shall be governed by Robert's rules of order.

AMENDMENTS

17.† The By-Laws can be amended by a two-thirds vote of those present at any regularly called executive committee meeting.

---

† Amended September 20, 1948.

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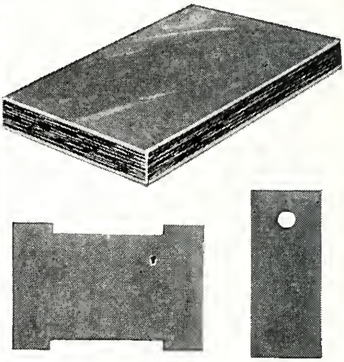
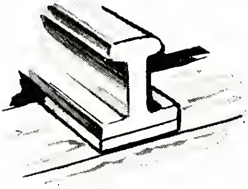
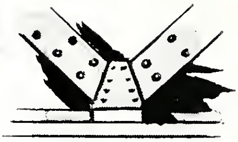


Bridges



Railroads



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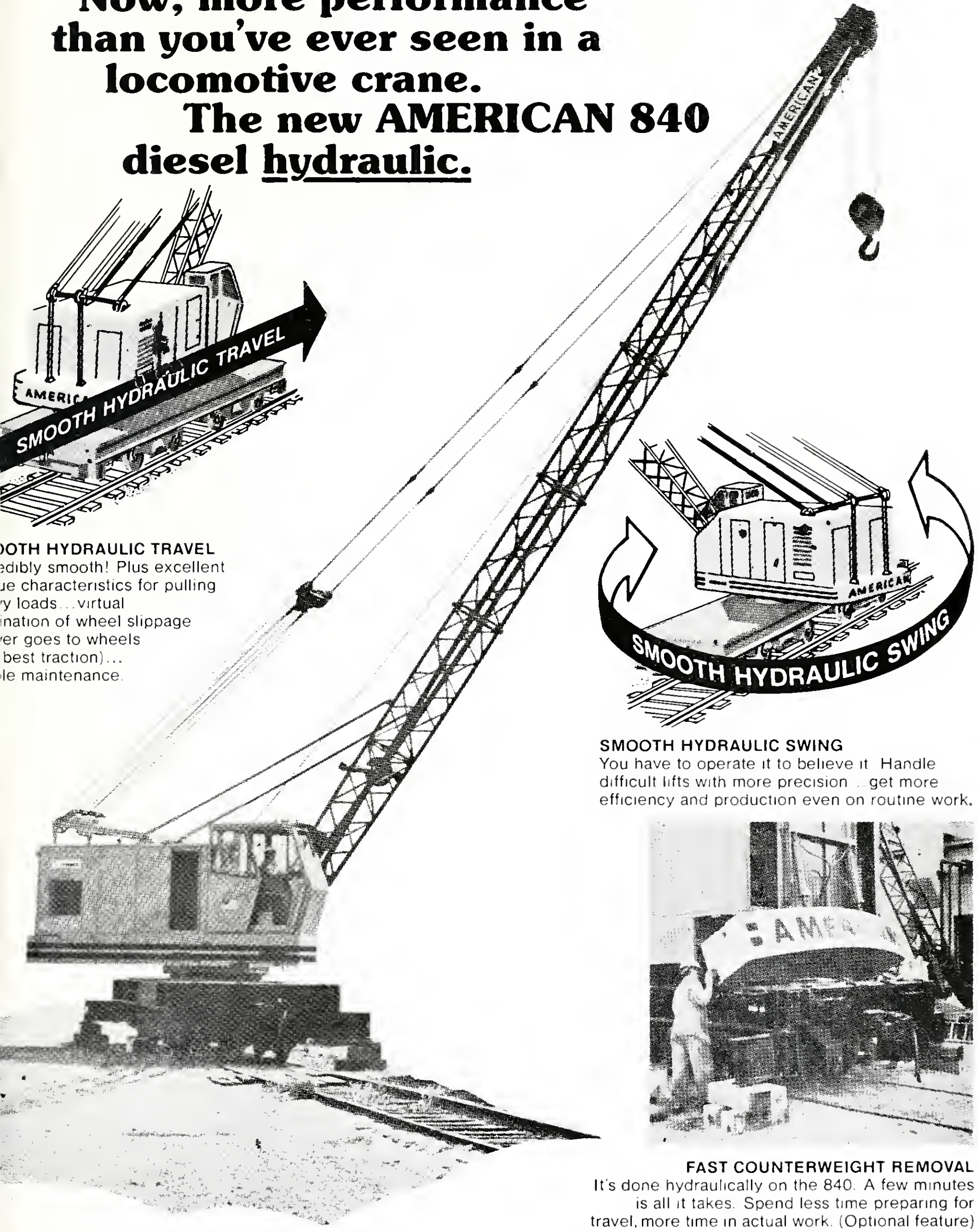

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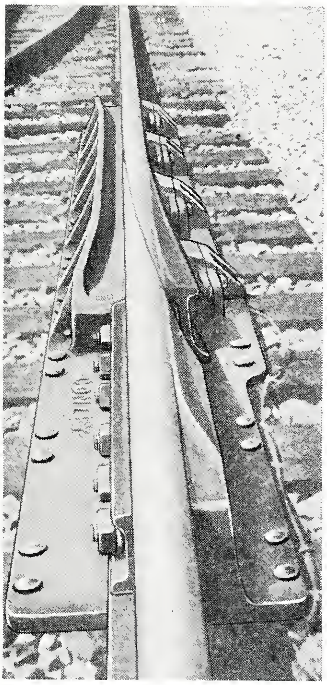

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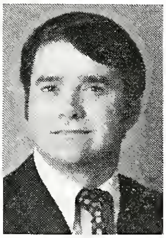

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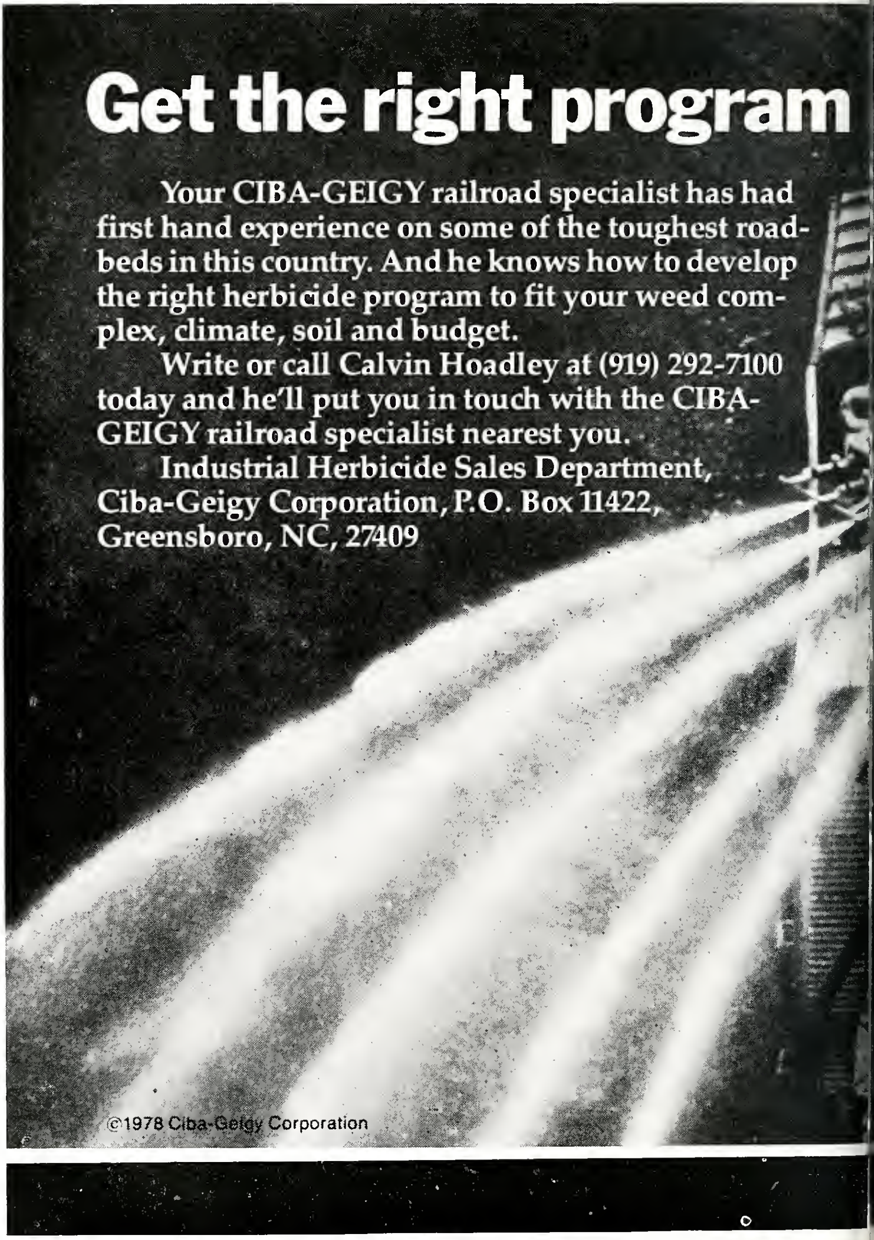

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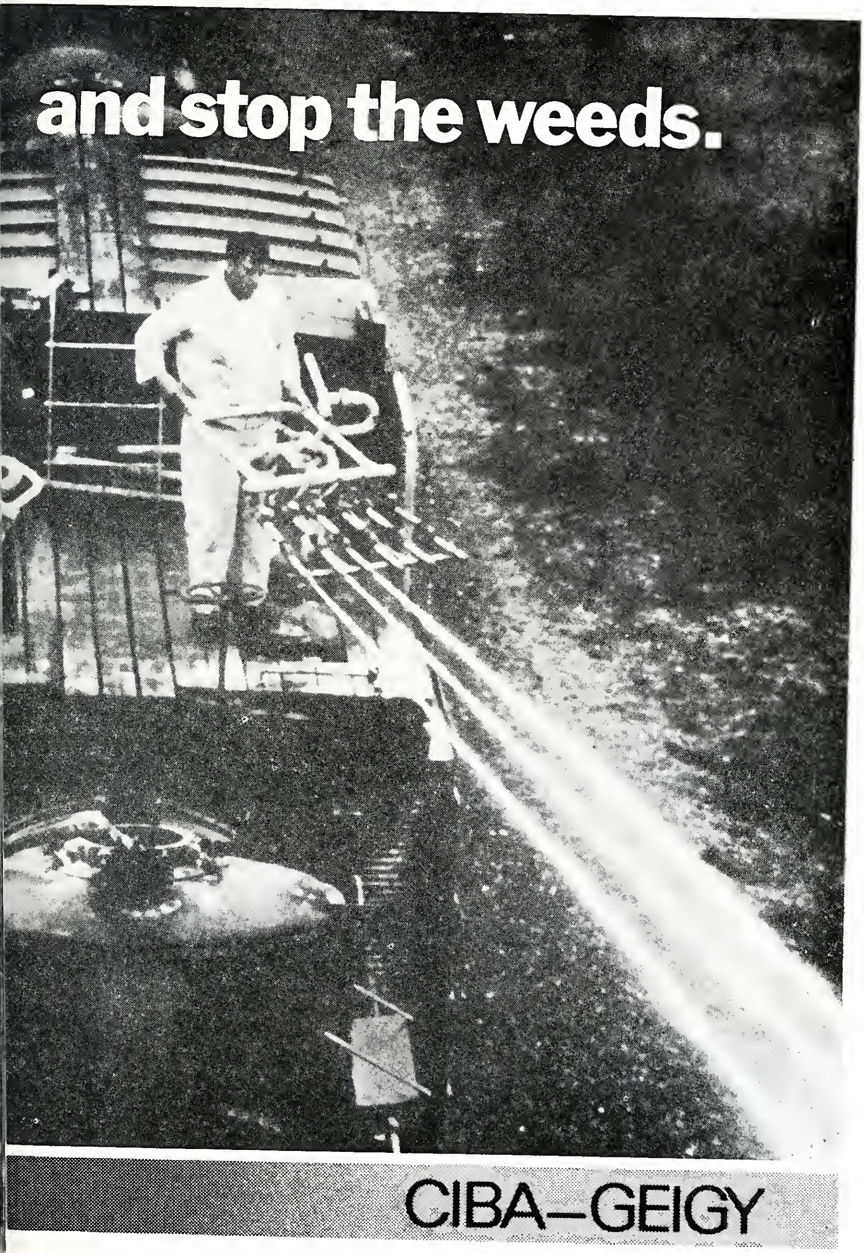
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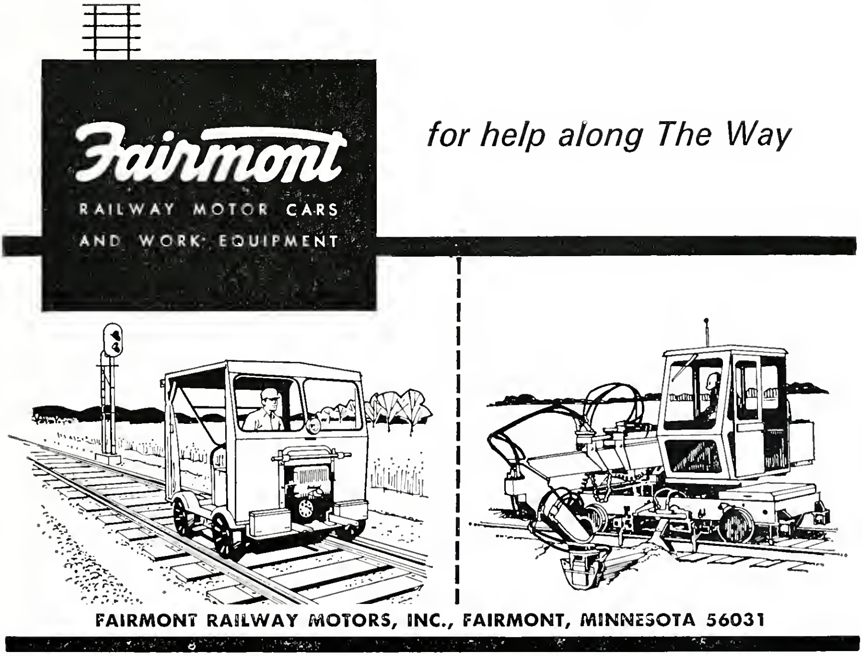
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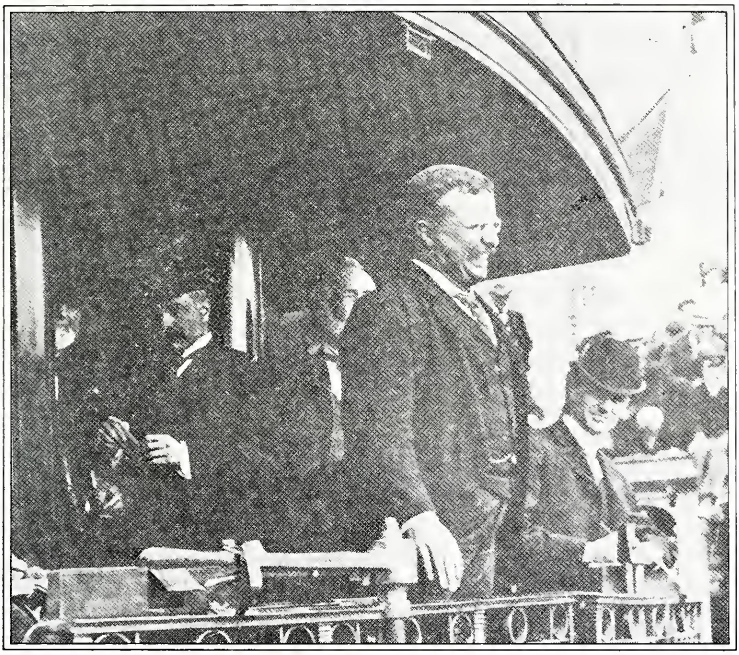

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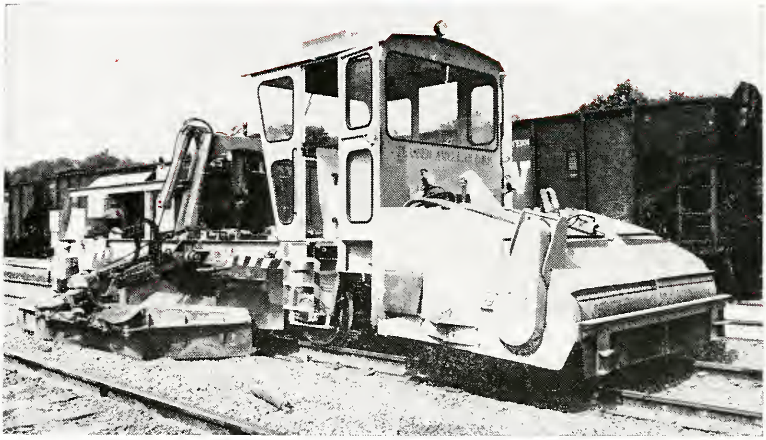

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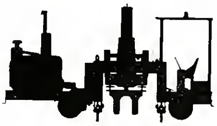

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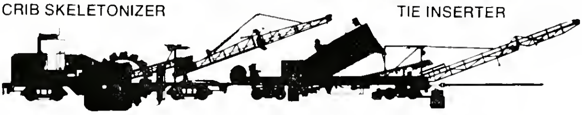

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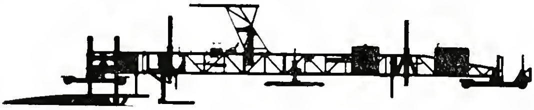

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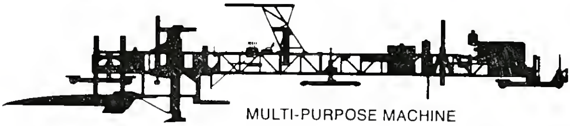

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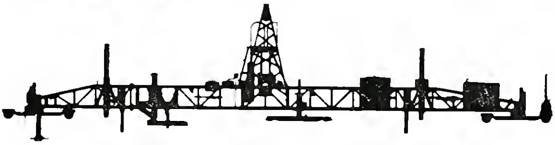

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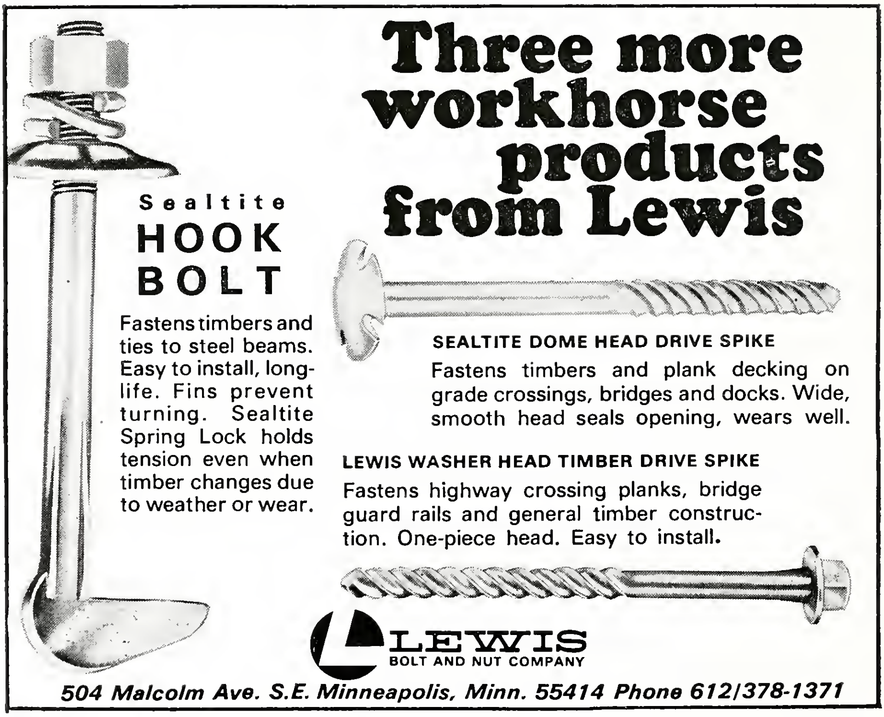

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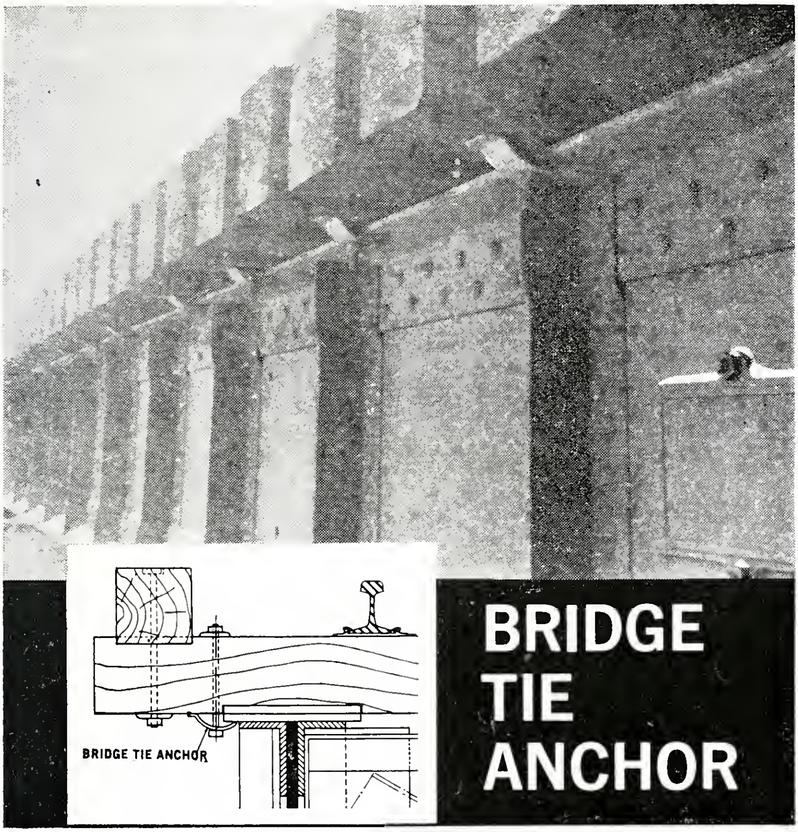

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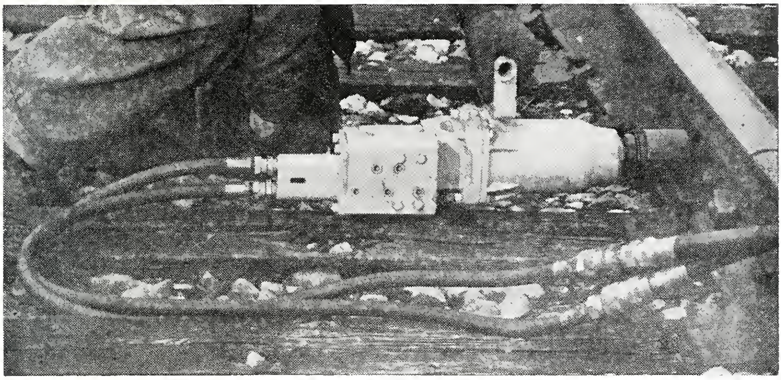

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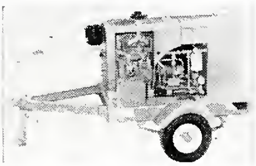

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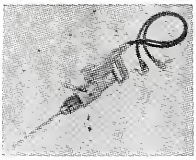

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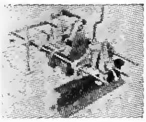

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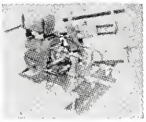

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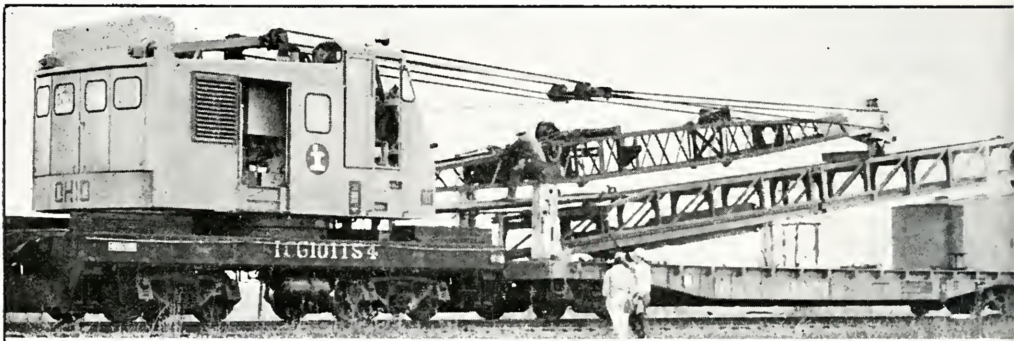

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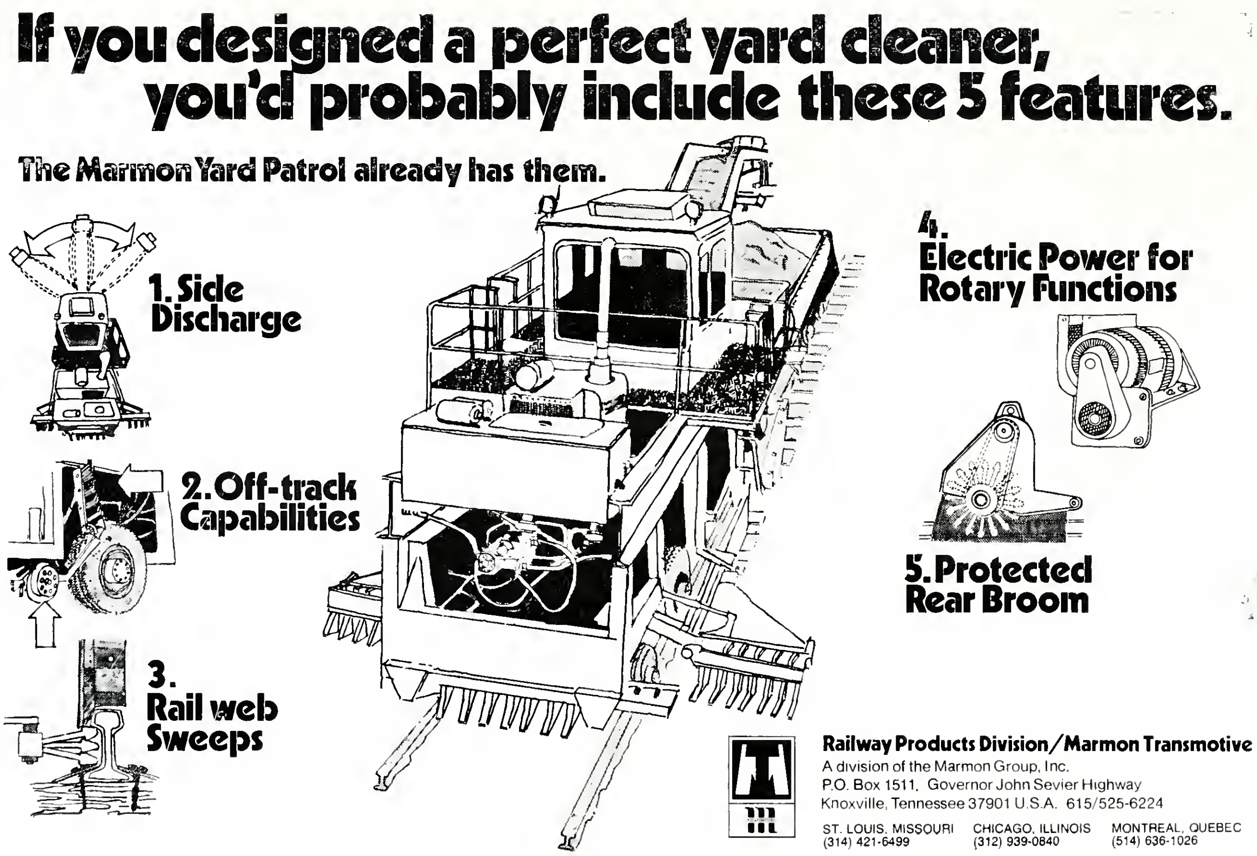

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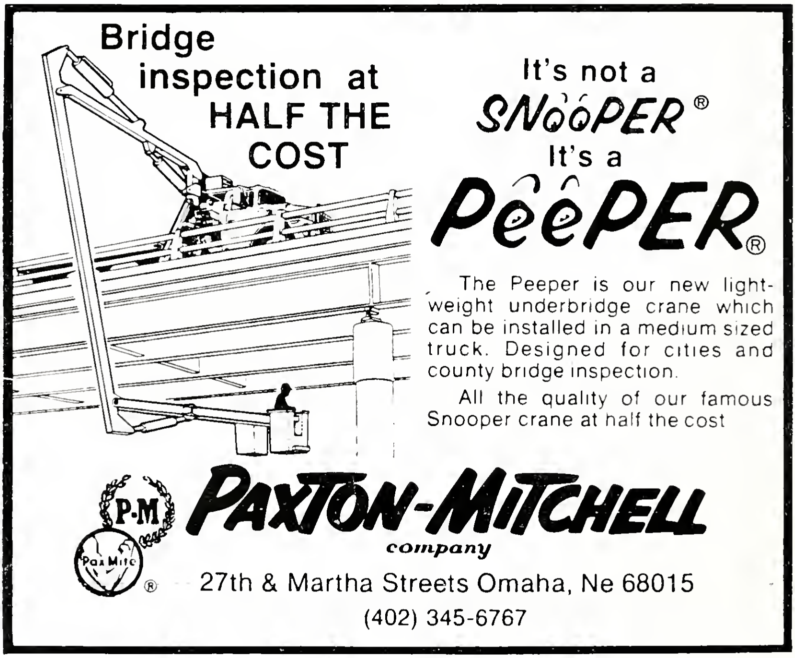
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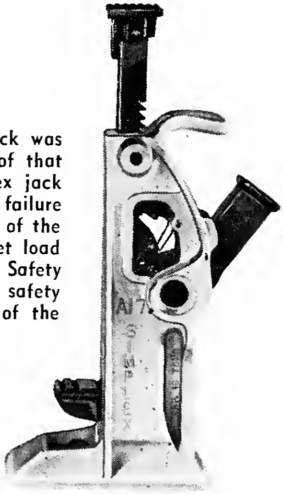

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1968-1976

VOLUME 73 (1968)

Committee Reports:

Latest Developments of "In-Place" Treatment of Timber Bridges (J. R. Williams, Chm)
Ways and Means of Repairing or Replacing Expansion Rollers Under Bridges (W. H. Prober, Chm)
Procedures for Replacing Timber Trestles With Steel and Concrete Structures (R. K. Corbett, Chm)
Centralized B&B Assignments Vs. Floating Gangs (G. W. Brenton, Chm)
Tools and Equipment For B&B Work (J. W. Chambers, Chm)
  Heavy Construction Tools for B&B Work (F. T. Odgers, Subcommittee Chm)
  Portable Power Tools for B&B Work (G. R. Vanderpool, Subcommittee Chm)

VOLUME 74 (1969)

Committee Reports:

Concrete Trestles Ties—Their Manufacture and Installation (A. C. Jones, Chm)
Prefabricated Panels for Bridge Renewals—Practicality and Economics (L. C. Harris, Chm)
Communication Between Management, Supervisors and Men (J. C. Hobbs, Chm)
Inspection of Masonry Structures and Steel Bridges (J. W. DeValle, E. E. Runde, T. A. Reynolds)
Tools and Equipment (J. W. Chambers, Chm)
  Heavy Equipment for B&B Work
  Portable Power Tools for B&B Work

VOLUME 75 (1970)

Committee Reports:

Maintenance and Renewal of Tunnel Linings (J. A. Caywood, Chm.)
Posting Piling Using Epoxy Resins (J. W. Storer, Chm.)
Progress in Development and Testing Track Scales for Coupled-In-Motion Weighing (A. L. Hunter, Chm.)
Waterproofing Railroad Bridge Decks (F. P. Drew, Chm.)
Rail-Highway Equipment (E. A. Albert, Chm.)

VOLUME 76 (1971)

Committee Reports:

Concrete-Filled Pipe Piles, Bents and Piers (D. T. Hughes, Chm.)
Recruiting of Qualified Personnel Into B&B Department (C. Gould, Chm.)
B&B Inspection Reports and Forms (W. C. Sturm, Chm.)

VOLUME 77 (1972)

Committee Reports:

Cast-In-Drilled-Hole Concrete Piling (K. L. Wammel, Chm.)
Steel Protective Coatings (W. R. Hyma, Chm.)
Weathering Steel (J. W. Davidson, Chm.)
Prestressed-Concrete Railroad Bridges—New Developments, Problems, Etc.—(C. A. Hughes, Chm.)

VOLUME 78 (1973)

Committee Reports:

Water and Air Pollution As Applicable to B&B Work (W. G. Byers, Chmn.)
Precast Concrete Caps for Timber Bents, Steel and/or Concrete Piling (J. Payne, Chmn.)
Revising Work Practices to Minimize Traffic Interference (R. C. McMaster, Chmn.)

VOLUME 79 (1974)

Committee Reports:

Inner and Outer Guard Rails on Bridges (J. R. Iwinski/J. C. Hobbs, Co-Chmn.)
Protection of Bridges Over Navigable Streams (M. Noyszewski, Chmn.)
Concrete Restoration (B. J. King, Chmn.)

VOLUME 80 (1975)

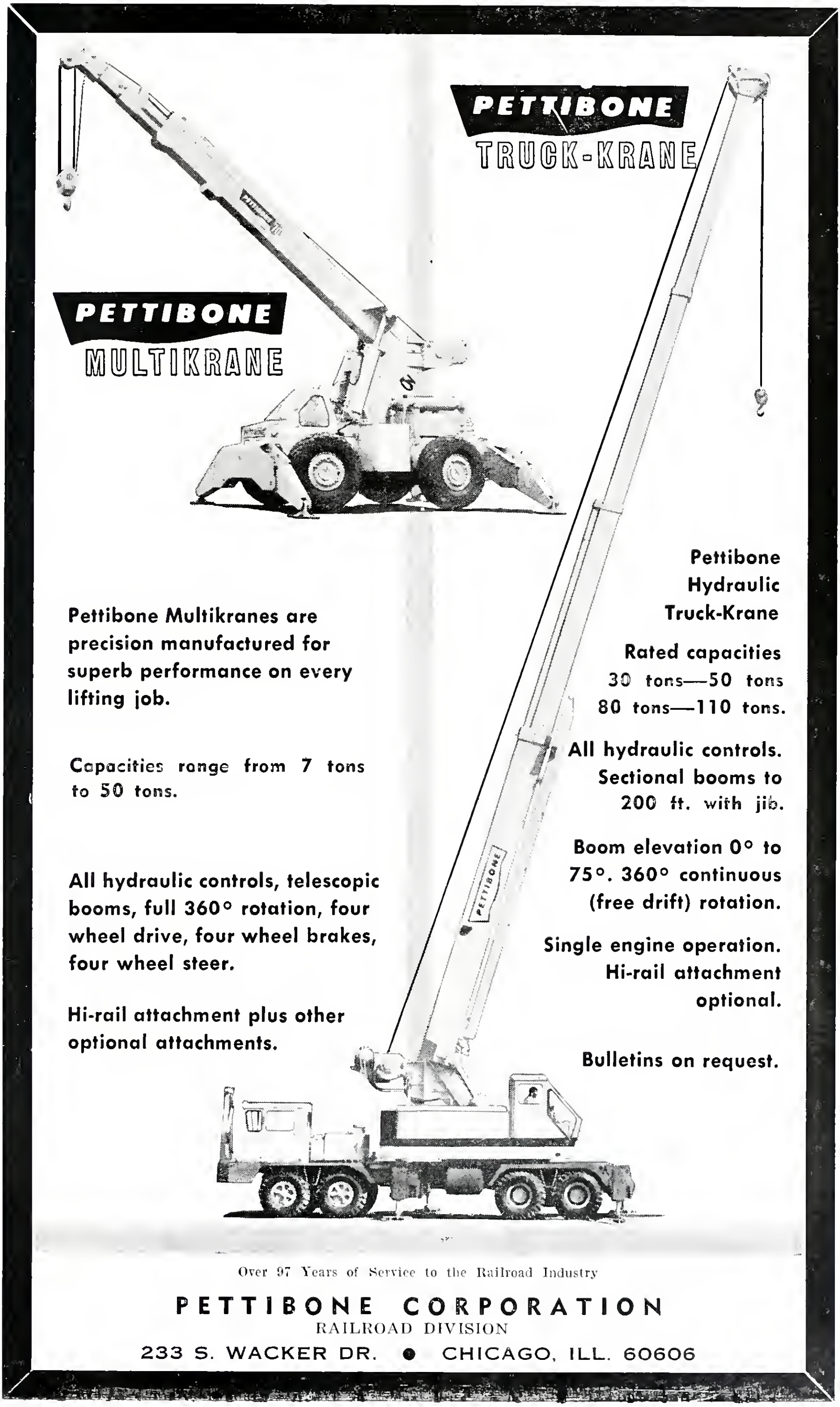
Committee Reports:

Trends Toward Bridges Built with Combination Timber, Concrete and Steel Components (J. G. Robertson, Chmn.)
Fire Protection Systems for Bridges and Buildings (W. E. Halley, Chmn.)
Controlling Water Pollution at Mechanical Facilities (W. J. Gunkle, Chmn.)
Selection and Maintenance Mechanical Facilities for Buildings (W. C. Sturm, O. C. Denz, F. D. Day, E. B. Dobranetski and J. L. Gray)

VOLUME 81 (1976)

Committee Reports:

History of Railroad Bridge Development (James Budzileni, Chmn.)
Planning and Scheduling B&B Work (R. C. Force, Chmn.)
Problems Encountered In Remodeling Existing Buildings (W. C. Sturm, Chmn.)



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